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[OFFICIAL NOTICE.]

Twenty-fourth General Meeting, American Gas Light Association.

OFFICE OF THE SECRETARY,
PROVIDENCE, R. I., October 7, 1896.

There will be an adjourned annual meeting of the American Gas Light Association held in St. Louis, Mo., on October 27, 28 and 29, 1896.

The meeting will be called to order by the President, C. J. R. Humphreys, of Lawrence, Mass., at 9:30 o'clock, A.M., on Tuesday, October 27, in the meeting hall at the Planters' Hotel, the headquarters, which occupies half a block on Fourth street, between Pine and Chestnut.

The Planters' is one of the very finest hotels in the West, and is conveniently reached by the principal street car lines, and is amply large enough to take care of all who attend the convention. The most satisfactory quarters are always obtained by writing in advance to the hotel people, and in doing so a reply should be requested, for which a self-addressed stamped envelope should be enclosed, as misunderstandings may thereby be averted. The Planters' is conducted on both the American and European plans. On the American plan there will be a few rooms at $3.50, plenty of rooms at $4, with bath, $5; or two adjoining, with bath between, $4.50 each, and up. European plan, $2 and $2.50 and up. Rates are the same for corresponding rooms on all floors above the third. The Southern Hotel is a fine house at Broadway, Fourth and Walnut streets, 2½ blocks from the Planters', and is American plan, $3 to $5 a day. The Lindell is a good house on Washington avenue, between 6th and 7th streets, six blocks from the Planters', and is American plan, $2.50 to $4.50 a day.

The change of date from the third Wednesday of October was made positively necessary by an entirely unforseen occurrence. During the first week of that month St. Louis is filled with visitors to the fall festivities, and this year the second week was chosen for the meetings of two very large associations, the Carriage Makers and the Street Railway people; but as the hotels would be unable to take good care of two such large conventions at the same time, the Street Railway convention was changed to the week of the third Wednesday, and as that convention meant about 3,000 persons in attendance, our members could not have been comfortably housed. The President and Secretary therefore went to St. Louis, and after mature consideration in consultation with the local members, it was finally decided that to hold our meeting on Tuesday, Wednesday and Thursday, October 27, 28 and 29, was the best arrangement that could be made.

In order to have the meeting of the 27th strictly in accordance with the Constitution, the annual meeting will be held at St. Louis on the date provided by the Constitution, namely, the third Wednesday of October. It is not expected to transact any business then, but with the assistance of the members already provided for, adjournment will be had to the date mentioned at the beginning of this circular, namely, Tuesday, October 27, at 9:30 A.M.

The meeting hall will be the Ladies' Ordinary, on the parlor floor of the Planters' Hotel; thus the headquarters and hall will be in the same building.

The roll call will be made by means of the door card system. Each member upon entering the hall for the first time will at the door receive a special card upon which he will find his name, address, etc., as it appears on the Secretary's books, and such card should be corrected and given to the doorkeeper. Members in attendance should attend to this very carefully, as these cards are used immediately after the meeting for correcting the annual membership list. Visitors will please hand to the doorkeeper their personal cards.

A blank form of application for membership accompanies this circular. More can be obtained of the Secretary.

Remember, all applications must be in the Secretary's hands by October 17, at the very latest, otherwise they will not be acted upon at this meeting.

The list of papers to be read at the meeting is as follows:

"A Discussion of the Methods Employed in Introducing Gas Stoves," by Charles H. Nettleton, Derby, Conn.

"Some Experiments on Internal Illumination," by Carter H. Page, Jr., Philadelphia, Pa.

"Inclined Retorts up to Date," by Frederick Egner, Norfolk, Va.

"A Modern Retort House," by Wm. A. Miller, Cincinnati, O.

"The Separation of Water Gas Tar," by Alten S. Miller, Long Island City, N. Y.

In addition to the above there will be several topics brought in for discussion by short written introductions. Three of the short topics already provided are:

1. "An Experience with Prepayment Meters."
2. "Wet or Dry Heat—which Gives Best Results in Purification?"
3. "The Use of the Jet Photometer."

All questions for the Question Box should be sent in to the Secretary as soon as possible in order that they may be printed in the next circular before the meeting, thereby insuring their discussion.

During the days of the meeting all announcements will be posted on the bulletin board in the meeting room. All members are warned to take notice thereof accordingly.

All members attending the meeting are particularly requested to wear their membership badges in plain sight, thereby greatly aiding the offi-

cers and the Local Committee in their work, by affording a ready means of recognition.

In order that the Year Book containing the report of the St. Louis meeting may be published and issued to the members immediately after the meeting, notice is hereby given that if any of the speakers at that meeting desire to correct their remarks in discussions before they are printed, they will be given an opportunity before leaving St. Louis, but *not* after. The stenographer will have typewritten copy of the principal discussions prepared at the headquarters between the sessions of the meetings, and all those who desire to correct their remarks *must* notify the Secretary at the close of the session at which such remarks are made, as all the report will be turned in to the printer immediately after the adjournment of the meeting.

Special rates for transportation have been granted (viz., full fare going and one-third fare returning by the same route) by the several Passenger Associations named and under the conditions noted.

The Central Passenger Committee, covering the following grounds: Bounded on the east by Pittsburgh, Salamanca, Buffalo and Toronto; on the north by the line of and including points on the Grand Trunk Railway from Toronto to Port Huron, thence via Lakes Huron and Michigan to the north line of Cook county, Ills.; on the west by the west line of Cook county and the Illinois and Mississippi rivers, to Cairo, including Burlington, Keokuk, Quincy, Hannibal and St. Louis; and on the south by the Ohio river, including points on either side of that river.

The Southern States Passenger Association, covering the territory south and west of the Virginias and south and east of the Ohio and Mississippi rivers.

The Trunk Line Passenger Committee, covering territory west of New England and east of Niagara Falls, Buffalo and Salamanca, N. Y.; Pittsburgh, Pa.; Bellaire, O.; Wheeling, Parkersburg and Charleston, W. Va.

The New England Passenger Association, covering nearly all of the lines in the New England States.

The Western Passenger Association, from points in Eastern Committee and Trans-Missouri Committee Territories.

The following extracts from the regulations of the railroads are cited for the information of the members. The special rates are granted subject to these regulations:

1. The reduction is conditional on there being an attendance at the meeting of not less than 100 persons holding certificates.

2. Each person to obtain the excursion rate must purchase a first-class ticket (either limited or unlimited) to the place of meeting, for which he will pay regular fare, and upon request the ticket agent will issue a printed certificate of purchase of the standard form. Agents at all important stations are supplied with certificates.

3. If through tickets cannot be procured at the starting point, purchase short-trip ticket to the most convenient point where such through tickets can be obtained, and there purchase through to place of meeting, requesting a certificate from the ticket agent at the point where each purchase is made.

4. Tickets for the return journey will be sold by the ticket agent at the place of meeting at one-third the highest limited fare, only to those holding certificates signed by the ticket agent at point where through ticket to place of meeting was purchased, and countersigned by signature written in ink by the Secretary of the Association, certifying that the holder has been in regular attendance at the meeting.

5. No reduction of fare will be made on the return passage if the going ticket is purchased more than three days before the opening date of the meeting; except that when meetings are held at distant points to which the authorized limit is greater than three days, tickets may be purchased before the meeting in accordance with the limits shown in regular tariffs.

6. Certificates are not transferable, and return tickets secured upon certificates are not transferable. The transfer of any such is liable to prevent the securing of reduced rates for future meetings.

7. The certificate of agent at starting point, duly endorsed by Secretary of Association, must be presented to ticket agent at place of meeting, within three days (Sunday not reckoned except by Southern Passenger Association) after adjournment of meeting. The return ticket will be for the line or lines covered by the going ticket.

8. No refund of fare will be made on account of any person failing to obtain a certificate.

Special.—Those wishing to join the New York party should communicate with C. E. Sanderson, 32 Pine street, N. Y. City. Be sure to obtain your railroad certificate when buying your ticket for St. Louis. Apply for ticket and certificate at least 30 minutes before train time. Each person must sign his own certificate at time of purchasing ticket for St. Louis. Be sure to have the Secretary endorse your certificate at St. Louis as soon as you get there. Apply for return ticket at least 30 minutes before train time, and have your certificate with you. Any person, ladies included, attending the meeting, is entitled to the reduced rate from the territories named.

Members will please hand their certificates to the Secretary, or his Clerk, upon arrival at place of meeting. If there are one hundred members present, holding certificates, each certificate will then be properly endorsed and handed back to owner before adjournment.

Extracts from the Constitution.

Sec. 12. Application for active membership or for associate membership, or for transfer from associate to active membership, must be received by the Secretary at least 10 days prior to the meeting at which the application is acted on.

51. No member who owes two years' dues shall be entitled to vote, or to participate in the deliberations of the Association, or to receive a copy of the proceedings.

52. Any member whose dues shall remain unpaid for a term of three years may be dropped from the roll of membership by a vote of the Council.

A. B. Slater, Jr., Secretary.

BRIEFLY TOLD.

An American Exhibition of Gas Appliances.—It looks that we are at last to have an exhibition of gas appliances in America; for official pronouncements to that effect have been put out by the gentlemen in charge of the direction of "The Gas Industries Company, Incorporated;" the offices of which Company are located in 280 Broadway, N. Y. A reference to our advertising columns (p. 576) will show that the arrangements for the exposing to the view of visitors to the exhibition of everything standard or novel in connection with the gas industry of our time and day, are quite complete, so far as the ingenuity of Mr. E. C. Brown, the Managing Director of the proposed display, can be depended upon. Certainly, The Gas Industries Company is numerically and capably officered, because its list of 32 Directors holds the names of at least 24 men, who stand now, as they stood for many years, for about everything of straightforward value with which the gas business is concerned. It might be that a Board fewer in numbers would have done just as well, but the appointment (we presume, of course, that the Directors selected the Executive Committee) of an Executive Committee of five (Messrs. E. C. Brown, Emerson McMillin, W. E. Barrows, W. H. Bradley and Walton Clark) has very much simplified, and necessarily, too, the work that such an enterprise entails; wherefore, it is to be considered that the naming of the Executive Committee arose mainly from the propinquity of each of its members to the other, thus insuring prompt action in the instance of speedy consultation. Beyond a doubt, though, there must have been some good reason for the failure to place the President of the Board of Directors (Prof. Chas. F. Chandler) on the Executive Committee, but as that reason is unknown, so far as the published prospectus goes, all must accept the action of those who named the executive management as appropriate and final. Apart from speculations like the above, and with the acknowledgment that Mr. E. C. Brown has been, and is, the promoter of the first American exhibition of gas appliances, we all must take it for granted that the desire of the gas makers is to see Mr. Brown through successfully. In fact, we are quite sure that Mr. William H. Bradley, Mr. Walton Clark and Col. W. E. Barrows (even if Mr. Bradley and the Consolidated Company will bear a good part of the brunt of the campaign), are quite up to having their full voice in arranging the preliminaries, in conducting the plan and in accounting for the results of the exhibition. The details of the exhibition, as gleaned from the circulars forwarded to us by Mr. Brown, on Wednesday, the 7th inst., are commonsense and excellent. The rate for floor space from intending exhibitors is, of course, not specified, and the regulations respecting the government of the exhibition are from the rules which ordinarily mark the carrying on of any use by the tenants of Madison Square Garden. The management has very sensibly put the admission fee at 25 cents, and it is proposed that the time of the exhibition shall be as Mr. Brown's circular puts it: "*Show Opens.*—Show opens Wednesday, January 27th, 1897, at 10 A.M., and each and every day thereafter from 2 P.M. until 11 P.M., until and including Saturday evening, February 6th, 1896." The length of the time named for the exhibition, according to our judgment, seems to be excessive, which thought is prompted by the fear that the use of gas, for any purpose not particularly new, will not have the merit of novelty for attracting, especially in this city, where many thousands of dollars have been expended by the local gas companies in teaching their customers what there really is in gas as a lighting and cooking medium. Our own wish is that the midwinter exhibition of "The Gas Industries Company" will be an unqualified success, and in any direction that we can aid the Company our services are at its command.

Notes.—There seems to be more trouble ahead for Mr. Addicks in his application to the Street and Sewer Department, of Wilmington, Del., for their assent to the removal of the disabilities respecting the piping of the streets of Wilmington by the Oxy-Hydrogen Gas Company, despite Mr. Addicks' attitude in the instance of the naming of electors on Republican presidential account in that State.——The Richmond (Va.) city gas works proposes hereafter to sell its gas tar product to the highest bidder.——The proprietors of the New York, Rutherford and Suburban Gas Company, of Rutherford, N. J., are extending their main system.——The gas men throughout the country seem unanimous in their reports that October is likely to be as good a gas consuming month as its predecessor was bad.

The Self-Enrichment of Coal Gas.

[A paper read by MR. R. G. SHADBOLT, of Grantham, England, before the Eastern Counties Gas Managers' Association.]

It might, at first sight, appear that such a well worn subject as that of gas enrichment is scarcely one to command attention, or one that is likely to yield anything new or interesting. However, as, like all else, the treatment of any subject must be judged on its merits, I venture to bring before your notice certain experiments, tests, etc., and deductions therefrom, which are at any rate additions to the writer's store of knowledge, and leave the verdict with you.

Without in any way reopening the controversy as to whether or not enrichment in the ordinary sense is of any real advantage to either manufacturer or consumer, let it be admitted that, under present day conditions, enrichment of one kind or another is, generally speaking, a necessity ; and however unwilling we may be to acknowledge the fact, we are compelled by force of circumstances to face the inevitable. When relating one's observations and experiences, it is often of advantage to not simply give a summary of the matters in question, but also an outline of the course of events which led to those conclusions, and, in so doing, it is most interesting at times to note how one line of experiments leads to another, and how ofttimes experiments develop in quite an opposite direction to that originally expected.

Most gas managers at some time or other would appear to dabble more or less in experimental work—thanks, in a great measure, being due to our District Associations and Institutions—and in the present case, as in many others, it was while following this bent, and experimenting in a certain direction (though with a view to attaining a similar end), that another line of experiments suggested itself, which has culminated in what I have the honor to place before you to-day. It is now some two years since the foregoing set of experiments were commenced. Like many another, the writer has been under the spell of gas enrichment by means of coal tar, and it was really while pursuing this will-o'-the-wisp that the idea leading to the present conclusions was conceived.

Without going into details of attempts at tar enrichment, which have no direct interest for us at present, suffice it to say that at this time clouds of heavy tar gas and vapor—but principally the latter—were entering the hydraulic main, and there intermingling with the foul coal gases from the retorts. Such a body of heavy vapors, as can readily be understood, was almost certain to condense out, thereby undoing all that was being attempted ; and while cogitating as to the best method of preventing this, the thought occurred that, if a portion of purified gas was returned into either the foul or hydraulic main, the whole becoming to some extent diluted—or, to speak more scientifically, thereby altering the vapor tension—the enriching vapors might be more easily carried, and subsequently fixed. Before, however, anything further was attempted, the fates decreed that a short interval should elapse, which gave one due time for reflection. Reflection carried one a step farther, for, provided returning a portion of the purified gas did in practice assist to carry forward hydrocarbon vapors which would otherwise condense out, it was simple logic to conclude that the same process would attain the desired end by preventing the precipitation of the vapors contained in the ordinary foul gas; and as simplicity is a desideratum, and prevention universally recognized as being better than cure, preparations were made, as soon as convenient, to put this notion to a practical test.

For the sake of clearness, it will perhaps be better to divide the treatment of the returning gas into two separate heads—viz., from whence returned, and the point returned to. Dealing, then, with the latter first, it was deemed advisable to intermingle the crude and returning gases at as early a stage as possible—having due regard to convenience—and also to provide the returning gas tubes with steam jackets or other equivalents immediately prior to the introduction of the returning gas into the foul main, the object being the approximation of its temperature to that of the crude coal gas. Having regard to all the circumstances of the case, the point fixed upon for the introduction of the returning gas was that directly opposite the hydraulic main outlet ; and in order that the admixture should be the more completely effected, the returning gas was conducted halfway across the foul main, as shown in sketch No. 1, thereby impinging upon the center of the stream of gas issuing from the valve. As seen by the sketch, the bench consisted of four through beds of retorts ; and the fittings and connections for conducting the returning gas were alike on both sides. As previously mentioned, the other point to determine was that from whence the returning gas should be drawn. The idea was to return thoroughly purified gas; but as this would undoubtedly mean increased back pressure on the purifiers in winter time, it was decided to tap the inlet side of the purifiers, and connections were accordingly made with the outlet of the second scrubber—the scrubbers immediately preceding the purifiers. A 200-light wet meter was pressed into the service ; and taking advantage of the difference in pressures at the two points, any quantity of gas might be returned up to the maximum capacity of the meter.

Now all was in readiness, and a commencement duly made. The illuminating power of the gas at this time was about 16¾ candles ; but after returning it at the rate of from 12 to 15 per cent. of the make for 24 hours or so, a distinct improvement in the illuminating power of the gas was noticeable. This improvement continued gradually to increase until 19¼-candle power had been reached, and was upheld for some three or four days. Just at this critical and interesting point, changing conditions—the sworn enemy to the experimentally inclined—interfered ; and gradually, in spite of all efforts to prevent it, the illuminating power fell to 18 candles, and later on to 17¼ candles. Needless to say, such results were extremely tantalizing; and they may perhaps be the better understood if a brief *resumé* of the conditions be given. A moment's reference to sketch No. 1 will assist in this.

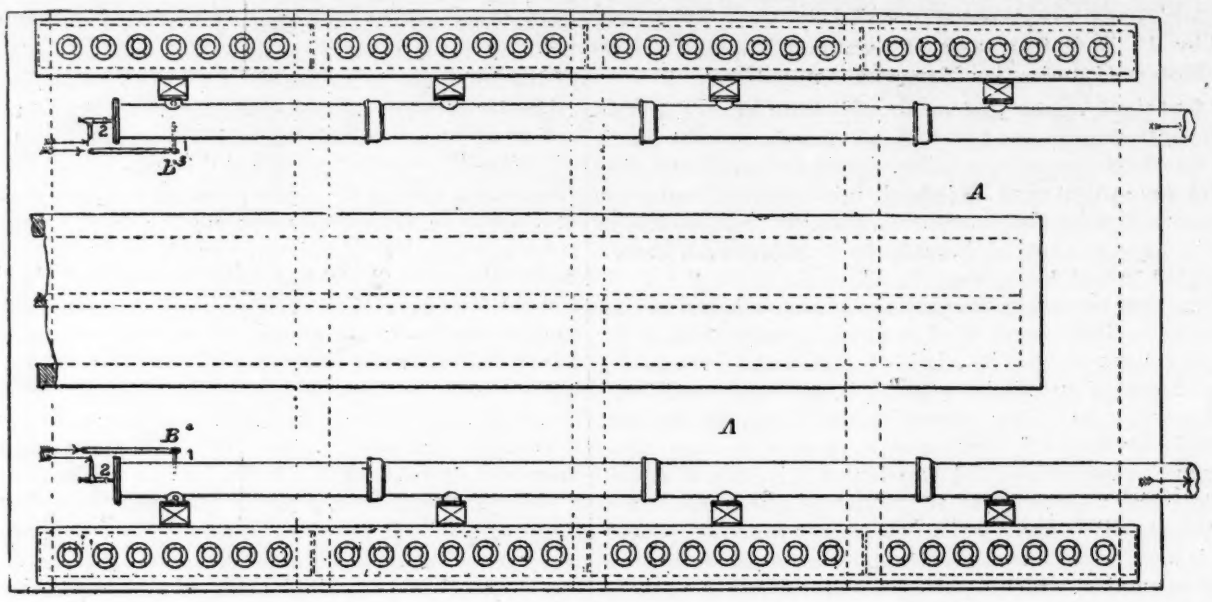
The retort stack as here shown has a separate hydraulic main to each single or half bed, likewise a separate valve and connection with the foul main. The three single beds, or through bed and a half (each half bed was workable as a single) marked *A* were at this time under fire, and it became necessary, on account of insufficient storage and for repairs, to light up and work the through bed marked *B* in their stead—in fact, knowing this transfer would be shortly made was the reason for connecting the returning gas tubes at point 1, as shown. Now it was while the beds *A* were working and beds *B* being prepared, that the maximum illuminating power of 19¼ candles—being an addition of 2½ candles—was reached ; but after transferring gas making operations to beds *B*, 17½ candles, or an addition of only ¼ candle, was the greatest increase obtainable.

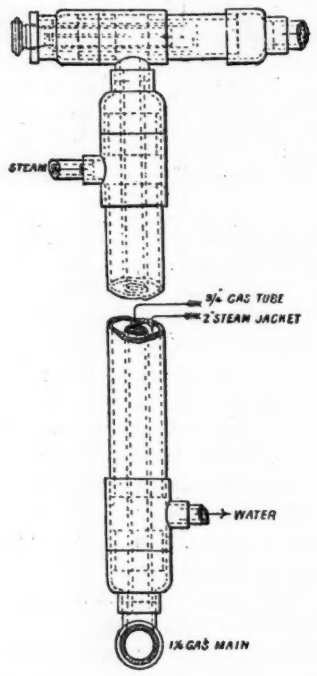
Having once secured an increase of 2½ candles, one did not relish giving up the game, and at the first rebuff, too. In fact, it simply served to whet the appetite. But how to account for this sudden fall in illuminating power was the problem, and a puzzling one, withal. One consolation was left, viz., that although the results had diminished so considerably, still some improvement remained ; but this was very erratic, coming and going in a most unaccountable fashion, the nice adjustment of temperatures notwithstanding. Upon consideration, it seemed just possible that the friction caused by the stream of returning gas impinging upon that of the foul gas, might precipitate condensation to some extent, and in consequence bring about the loss of some of those vapors it was so desirous to retain. An attempt was therefore made to secure conditions as nearly approaching those previously existing as possible, by changing the point at which the returning gas entered the foul main from 1 to 2—thus allowing the gases to intermingle more gradually ; but although a candle (and on one occasion as much as 1¼ candles) increased illuminating power was obtained, it was still very uncertain in its action, and quite uncontrollable.

Having pretty well exhausted one's resources at the foul main end, attention was again turned, by way of change, to the opposite, or point from whence the returning gases were drawn, as previously noted, from the clean scrubber outlet. The thought suggested itself that possibly the original idea of returning thoroughly purified gas had not been sufficiently adhered to ; and varying proportions of remaining impurities contained in the gas after its passage through the scrubbers might, to some extent, account for the fluctuations in enriching results. With a view of once and for all setting this matter at rest, gas was returned from the station meter inlet ; but here, as elsewhere, the unexpected happened, for instead of steading the fluctuating results previously obtained, they were lost entirely, and replaced by a slight actual decrease in illuminating power. This was taken as the danger signal, and a halt was accordingly made.

Here was something which had actually been in one's possession, and just at the time when the greatest hope and expectations had been inspired, it disappeared as by magic. There are times when one becomes desperate. A determination, born almost of despair, was formed that, whatever the result, a searching investigation of all available ground should be made. Hence, after being summarily put to the rightabout, measures were adopted for returning gas from every available point between the exhauster and station meter. The before mentioned 200-light wet meter was so connected that gas could be passed through it from either the first scrubber, second scrubber, purifiers, or station meter inlets, and be readily changed from any one to another.

Commencing at the station meter inlet, and systematically working backwards towards the exhauster, gradually improving results were obtained until, when returning gas in the proportion of about 8 per





cent. of the make from the second scrubber inlet, results almost identical with those in the first instance were obtained. But again history repeated itself almost to an hour; and after a few days of from 19 to 19¼-candle gas, the illuminating power again declined to about 17½ candles, playing the same pranks as before, and fluctuating in a most perplexing fashion. Having satisfied myself that approximately the right point had been determined from which to draw the returning gas, the opposite or foul end became again the subject of attention. This time thermometers were requisitioned, being placed respectively in the streams of foul gas issuing from the hydraulic mains, and that returning from the scrubber just prior to its entering the foul mains. Hourly observations of the temperatures at these two points were made, with a view to bringing them exactly alike; and, as a result, the root of the whole matter was discovered.

As previously stated, the returning gas tubes were passed through steam jackets at the foul main end; and hitherto sufficient steam had been circulated to raise the temperature of the returning gas approximately to that in the foul main—being judged by the sensible heat to the hand. The first thing noticeable after fixing the thermometers, was that the temperature of the foul gases varied tremendously; running up at times as high as 180° to 190° F., and at others, under apparently identical conditions, dropping as low as 110° Fahr. and under. One could readily understand a great difference in the temperatures of gases given off at various parts of the six hours (that being the duration of each charge); but this great difference was observed when comparing different charges at the same stage. Further observations went to show that when both beds of retorts were charged at the same time by coal from the same truck, and the heats were as near alike as it is possible to get them, the same unaccountable difference in the temperatures existed between the gases issuing from these two beds as had been previously noted when comparing different charges at similar stages in one bed only. Not only so, but whereas on one occasion the gas from (say) bed B3 would be 30° or 40° Fahr. higher than that from B4, at another time exactly the reverse would be found. At times this difference would remain fairly constant for a whole day, and at others would change backward and forward several times during a day. On some days the mean temperature of the gas from the two beds would be considerably higher than on others, and, of course, *vice versa*. This latter variation was doubtless due to atmospheric conditions, as the retort house was well ventilated; but the former differences cannot be accounted for so easily—indeed, the writer has so far made no further attempt to solve the problem. The principal interest centered in the fact that great variations in temperature did take place, and such as might account for the eccentricities hitherto experienced.

Now matters were coming rapidly to a head; for upon further observation, the variations in temperature of the foul gas were found to be practically identical with those of the illuminating power of the purified gas, and the best enriching results were obtained when the mean temperature of the foul gas was at its lowest. Here, then, was the matter in a nutshell. When the gas was produced in beds A, a lower temperature would reign in the foul main at the hydraulic outlet than when beds B were used, because A end of the stack was subject to much freer ventilation than the other; and one can only regret that actual temperatures were not taken at the time. However, definite knowledge had been acquired, and all that now remained was to put this knowledge to a practical test. At this stage, further tests became impossible for a time, owing to the writer's removal to another sphere of action.

Change of scene may have many advantages; but, generally speaking, along with these go hand-in-hand a fair proportion of disadvantages—possibly as a kind of counteracting agency. One of these disadvantages in the present case was the compulsory breaking off of tests of such an interesting character, and at such an interesting stage. However, although the removal of the writer to Grantham necessitated, in a sense, a fresh start, it was a start of an entirely different nature; for whereas at the commencement of the Low Moor experiment speculation was the principal stock-in-trade, at Grantham actual knowledge—the result of the former experiments—formed the basis of all operations. As has been pointed out, the problem had practically been solved, so that any further deviations would be simply of a modifiable character. The apparent disadvantage of a suspension of tests soon proved to be a real advantage, for no two sets of conditions could well be more diverse than those of Low Moor and Grantham. The only real loss was that of time (in itself a most valuable thing), which, in the present instance, served to mark a stage—the transition from the purely experimental to what one might term corroborative tests, the value of which was of necessity greatly enhanced when carried out under these altered conditions.

Tests of this kind cannot be resumed under such altered conditions at once, however desirous one may be to do so. Many things transpire for the first few months to monopolize the attention, and even when these are overcome, plant and instruments may require some slight alteration and modification. Take, for instance, the present case, where some relics only could be discovered of what had evidently at one time

served as a photometer, but which were such as to be quite useless in their original capacity. This and other considerations conspired to cause considerable delay—in fact, it was not until the beginning of this year that the corroborative set of experiments actually commenced.

Before proceeding further, it will, perhaps, be advisable to give roughly some idea of the different conditions existing at the two works —viz., Low Moor and Grantham. So far as we are at present concerned, the condensing, scrubbing and washing plant are all that need be compared, and this will best be done by stating their respective capacities :—

Works.	Condensers. Superficial Area.	Scrubbers. Cubical Contents.	Livesey Washer. Capacity per Diem.
Low Moor..	10,000 ft.	7,200 ft.	—
Grantham..	920 "	1,800 "	¾ million.[1]

* Recently erected.

Without giving exact figures, the maximum daily make of gas may be taken as 450,000 cubic feet in each case, so that the widely differing conditions will be readily appreciated.

Before commencing the enriching tests proper, it was deemed at least interesting to corroborate, or otherwise, the deteriorating effects of returning thoroughly purified gas. Briefly stated, the illuminating power of the gas was found to fall slightly under these conditions. Another side issue, however, made itself apparent—viz., the life of the purifier charges was materially extended thereby.

To return for the moment to the temperature observations made at Low Moor, the conclusion then arrived at was that the fluctuations of the temperature of the foul gas issuing from the hydraulic mains were too great to give constant results. Consequently a point must be determined nearer the condensers, where the temperature would be more constant and the mean somewhat lower ; for the best results were obtained at the lower temperatures. This point was found immediately preceding the condenser inlet, and the most suitable point from which to convey the returning gas was found at the outlet of the washer recently erected, between the exhauster and scrubbers.

With everything arranged in accordance with previous experience, a commencement was made ; the illuminating power of the gas going up within 30 hours from 15.75 to 17.89 candles. But before registering observations of any kind, the process was used at its full for about ten days, lest there should be any increased luminosity due to liquid or solid deposits then existing. That the observations might be of a most thorough and representative character, each alteration made in the proportion of returned gas, or in conditions of any kind, was continued for at least a week, and, where any doubt or uncertainty existed, for a fortnight. With the exception of three weeks' stoppage for coal testing, the test extended over five months, and comprised three distinct sets of tests. Each set consisted of ascertaining : First, the average illuminating power of the gas without the enriching process; then with the process on at full, and gradually tapering down again to the starting point. Each set of experiments lasted about six weeks.

The average summary of the five months' tests is as follows ("proportion" meaning the proportion of returned gas to the total quantity made thus—Proportion "A" being the lowest or minimum, and "E" the highest or maximum):

Enriching Results.

			Candles (Average).
Without enricher	Illuminating power	=	16.04
With enricher proportion A.	" "	=	16.42
" " " B.	" "	=	16.65
" " " C.	" "	=	17.30
" " " D.	" "	=	17.72
" " " E.	" "	=	17.78
			16.04
	Highest average increase	=	1.74

This shows an average maximum increase of illuminating power of 1¾ candles, though in the winter season an increase of 2 candles is obtainable. But taking the average from January to July, the results are as above ; any illuminating power between the two points being quite under control. It should be stated that all the illuminating power tests were made from gas taken from the governor inlet, and when the output was at the maximum, so as to reduce misleading results to vanishing point.

Obtaining given enriching results at the governor-inlet and maintaining the same for any given length of time, are two distinct achievements ; and possibly the first thought occurring to the mind of the practical gas manager will be : "Is this enrichment of a permanent character ?" At any rate, such was the mental query of the writer when obtaining his best results, and to settle this matter, 80,000 cubic feet of gas enriched by this method from 15.75 to 17.95 candles was stored in a 100,000 holder on April 27, where it remained until August 5 (or at all events 60,000 feet remained in the holder ; 10,000 feet having been partly lost by leakage and the rest used.) It was then run into the town, illuminating power tests being made of every 10,000 cubic feet passed. As it may be of interest, as having some bearing on the question of diffusion during storage, I give the result of each test, with the average at the end :

Test No. 1 of first	10,000 cubic feet	=	16.93 candles.
" " 2 of second	" " "	=	17.18 "
" " 3 of third	" " "	=	17.01 "
" " 4 of fourth	" " "	=	17.02 "
" " 5 of fifth	" " "	=	17.24 "
" " 6 of sixth	" " "	=	17.19 "
			6)102.57
	Average	=	17.09

This shows a loss of 0.86 candle only after being stored for exactly 100 days, which, I think, is a much smaller loss than that sustained by most gases.

Having discovered such a simple and easy method of enriching gas, and satisfied one's self as to its permanency and general adaptability, the question of cost naturally arises ; for we cannot reasonably expect to increase the illuminating power of our gas for nothing. Evidently something is impoverished—doubtless the tar. If you remember, the returning gases were intermingled with the foul gases just before the condenser inlet, the foul and hydraulic main tars being drawn off at this point. Consequently the condenser tars only would be those affected. These were caught and measured, and they were found to be barely 1½ gallons per ton of coal carbonized. The enricher was thrown off for three weeks, and after clearing out all old tar, samples were carefully taken during the third week, sealed and marked "A." All tar was again removed from the condensers, the enricher was applied to the extent of 1¼ candles, and tar samples were taken during the third week as before, sealed and marked "B." These two samples were submitted to a careful commercial analysis in due course, the report of which is as under :

Analysis and Report on Two Samples of Tar, marked "A" and "B," received from Mr. R. G. Shadbolt, Gas Works, Grantham.

Both samples of tar were thin and of light specific gravity, being drawn from gas condensers.

SAMPLE "A."—Being the tar produced in the condensers in the process of ordinary working.

SAMPLE "B."—Being the tar produced in the condensers during the process of enrichment to the extent of 1¼ candles.

(The specific gravity of ordinary tar = 1180/1200.)

	Sample "A."	Sample "B."
Specific gravity, water = 1.	1.135	1.134
Products by weight—		
Water.....	1.90 per cent.	1.74 per cent.
Crude naphtha	8.10 "	7.57 "
Light oil.....	9.26 "	7.26 "
Creosote.....	25.57 "	22.00 "
Anthracine and heavy oils	21.48 "	19.35 "
Pitch.....	33.00 "	41.30 "
Loss.....	0.69 "	0.78 "
	100.00	100.00

The distillation was carried to the same point in each sample.

Commercially there is very little difference in the value of the two tars.

There is a small but distinct difference in the percentages of the lighter oils, sample "A" being slightly richer in benzols than "B." The percentage of heavier oils is also greater in "A" sample than "B," while the "B" sample contains a much higher proportion of pitch.

The samples dealt with were too small to permit of the determination of the quantities of pure anthracine and carbolic acid, which, however, would not materially affect the relative commercial values of these tars.

(Signed) W. R. CHESTER.

From the foregoing report—remembering that the tar analyzed represents only 15 per cent. of the total quantity made, and that consequently the differences must be divided by 6⅔ to arrive at their total effect—we may safely conclude that the loss in value is infinitesimal, and may be dismissed as a negligible quantity. In fact, greater differences than these exist between the tars produced from two different

coals in the ordinary way. The only real loss may be said to be in quantity, and may perhaps be the most easily arrived at from the pitch basis.

In comparing the two analyses, we notice that the proportion of pitch contained in sample "B" is 41.30 per cent. by weight, against 33 per cent. in sample "A," being an increase of 8.30 per cent. on the bulk, which practically represents the loss of oils, etc., due to the enrichment process, and made up as follows:

Loss due to Enrichment.

Crude naphtha	0.53 per cent.
Light oil	2.00 "
Creosote	3,57 "
Heavy oils, etc	2.13 "
Total	8.23

For all practical purposes, therefore, we may take it that the loss in quantity is equal to 8.3 per cent. of the condenser tars variously expressed below:

8.3 p.c. condenser tars absorbed	per	1¼ candle	per	10,000 c.ft.	enrichment.
1.245 p.c. of total tar made	"	"	"	"	"
0.996 " "	"	1 candle	"	"	"
0.0996 gallon of tar used	"	"	"	"	"

Cost per candle per 10,000 c.ft. tar at $6.25 per ton = 0.30 cent.

Needless to say, such results far exceeded the author's expectations; and, indeed, it may be that some small proportion of tar deposited in the condensers when working without the enricher remained, and to some extent affected the composition of sample "B." But if this be so—and the greatest possible care was taken to prevent it—and the tar lost be double that shown, we still have the ridiculously low figure of 0.6 cent per candle per 1,000 feet for enriching material, which, I think, may be safely claimed as the lowest on record. In casting round for a reason for such extraordinary results, and in reference to the analysis, one is forced to the conclusion that they are due to the utilization of heavy hydrocarbons without carbonizing or cracking them up, when a great proportion go to make gas of a lower illuminating power; but be the reason what it may, the results remain.

Little more remains to be added, save sundry notes made incidentally during experiments.

1. When working without the enricher, oil accumulates in the washer; but when the enricher is worked at full, no oil is deposited. The quantity of oil deposited varies *pro rata* to the extent of the enrichment.

2. Contrary to expectations, too much gas may be returned. If a certain proportion be exceeded, the illuminating power begins to fall.

3. Within certain limits, the temperature of the returning gas appears to be immaterial, provision only being made for slightly raising the temperature in frosty weather.

4. The same maximum illuminating power is obtainable summer and winter—*i. e.*, the enriching effect is greatest in the winter time, when it is most needed.

5. The flame from a given illuminating power is apparently whiter than that of the same illuminating power obtained in the usual way—and shows rather better in the jet than the bar photometer.

6. This method of enrichment is simplicity itself, and requires no labor expenditure.

7. It is applicable under widely differing conditions.

8. And is perfectly under control.

Allow me to add, in conclusion, in order that misconceptions and confusion may be avoided, that this method of gas enrichment is patented, and has, in fact, been under protection since June, 1895.

Observations on the Construction and Working of Regenerator Settings.

[A paper read by Mr. W. J. Jenkins, of Retford, England, before the Eastern Counties Gas Managers' Association.]

To one who has an observant disposition and takes an interest in details, few things in gas works are more striking than the great diversity in the ways of working regenerator settings. Some difference must, of course, arise in every place, owing to differences in the sizes of chimneys and in the prevailing direction and force of the wind, which affect the draught; but even allowing the widest limits for such influences, the divergences in the area of opening of the primary and secondary air supplies are still far greater than would be expected. In one gas works all the secondary air required for a setting of nines will have to pass through two openings 4½ inches by 1½ inches; while in another the openings will not be less than 6 inches by 4 inches. What is the reason for this state of affairs? It is very probable that, by frequent trial and error, the particular opening arrived at in each works is the one which gives the best results as regards the production of gas, although the consumption of coke in the producers may, or may not, be the lowest possible. It is by no means an easy thing for an experienced stranger to make a complete rearrangement of dampers and air slides in one gas works to suit experience gained with other settings in another works, or to fit any theory, yet there should be little more difficulty in doing this than there is in setting the valves of a steam engine, provided the construction of the furnace and passages can be referred to some standard proved by frequent practice to be in accordance with a reasonable theory. To point out divergences from such a reasonable theory, found in many types of construction, and to evoke discussion on the opinions advanced, is the object of this paper.

The number of pounds of coke to be consumed per hour in the producer is the starting point in the design of a setting; and when that quantity is settled, the amount of primary air is also settled by a very simple calculation. If we knew the draught in the ashpit we should be able to proportion the area for primary air without very much trouble. But in most cases such a calculation would be quite useless, because we should not know what leakage of air was taking place because of badly built brickwork and leaky doors. You might, in many cases, close all the air inlets designed for the purpose, and yet have more producer gas generated by leakage than is needed to work the setting.

Tight, well-fitted doors are, therefore, almost as necessary at the ashpit as on the retort mouthpiece. The area of the grate is usually such that 5 to 6 lbs. of coke are gasified per hour per square foot where producers are on both sides of the stack; but 10 to 11 lbs. per square foot can be gasified with very little draught, and consequently one producer per through setting answers very well. Indeed, where economy of coke is the first object aimed at, the single producer has the advantage of being less likely to waste fuel, because it is worked nearer its limiting capacity. As regards the use of steam below the grates, it is a fact that producers for steel melting and other metallurgical purposes are now almost invariably supplied with steam jet blowers, because of the now perfect control attained and the better gas produced; and certainly the steam must be much better distributed amongst the air in the forced draught system than in any other.

The question as to what is the proper temperature for a producer is best answered by saying that the higher the temperature, up to 2,000° F., the better the gas produced; but the temperatures need not be so high as to damage the brickwork, for Ledebur has shown that the reducing action takes place most effectively between 1,600° F. and 2,000° F. By passing dry air through coke at 660° F. it was found that the resulting gas contained 85.2 parts of carbonic acid to 14.8 parts of carbonic oxide. At 970° F. the result was 79.6 of carbonic acid and 21.4 of carbonic oxide; while at 2,000° F. the proportions were 2.2 of carbonic acid and 97.8 of carbonic oxide. Akerman confirmed these results by passing carbonic acid gas through charcoal kept at a given temperature. At 606° F. no carbonic oxide was found; at 740° F. 0.4 per cent. of carbonic oxide; and at 1,684° F. there was 10 per cent.

The next points of construction to be attended to are the size and position of the outlets or nostrils in the producer arch. Generally, the nostrils are too large, and frequently they are in the wrong position. The former fault arises mostly from a fear of choking up in working, but with proper fire-resisting material there need be no great change in the size from season to season, and a damper brick can be placed in such a position as to regulate the opening, while being movable from outside. If the setting is worked under a sharp draught there is always a chance of severe cutting taking place with small nostrils; but in these days it should scarcely be necessary to say that it is almost impossible to get uniform heats all over the setting unless there is a slight pressure outwards under the arch, and when the dampers are arranged to give this there will be no fear of cutting action if the nostrils are large enough to take all the gas required, and yet not so large that one or two nostrils, more favorably situated as regards draught, get more than their share of gas. With dampers arranged as described there will seldom be more than the slightest draught at the crown of the producer arch, and the velocity of outflow of the gas will not exceed 12 feet per second. For a setting of eights carbonizing 3½ cwts. per mouthpiece four times per 24 hours, and consuming 13 lbs. of coke per 100 lbs. of coal carbonized, the area of the nostrils would work out at a total of 120 square inches, or, say, 12 nostrils, 5 inches by 2 inches, six each side.

The struggle for a combustion chamber has misled many gas engineers and ruined their settings. Combustion chamber, in this sense,

means a low-arched chamber (with side outlets) in which combustion is supposed to take place better than in any other way. Into these chambers the gas is frequently delivered through vertical nostrils in the crown of the arch. Cases of settings of nines are plentiful where the center bottom retort has melted down in a few weeks, while none of the other retorts ever reached a moderately good heat. In many cases the gas has been delivered into a so-called combustion chamber immediately under the center retort and through the center of the producer arch. In such cases intense combustion takes place in a very confined space, and high local heat, with very little diffusion, is the result. When the bottom middle retort has been removed, and the setting converted to eights, it has worked satisfactorily, although no change was made in the position of the nostrils. But if the nostrils had been in the right place there would have been no difficulty with the nines. The best combustion chamber is the highest space to be found inside the setting, and that in a setting of nines or eights is the space between the middle and side retorts; consequently there should be two rows of nostrils, one on each side of arch, in such positions that the flame will ascend verti cally in the two free spaces between the retorts. For settings of sevens no better arrangement need be desired than that having three retorts in the top tier and two for the other two, with vertical nostrils in the arch. There is sufficient height for the flame to develop in this case, and a peep inside a setting of this sort, as arranged by Mr. Carpenter, of Vauxhall gas works, is a liberal education in gaseous combustion. How important it is to have height for the flame to develop in can best be appreciated by remembering that in a free space the flame would be yards high. No gas engineer would expect to get a good heating effect by placing a body close down on the top of an ordinary gas jet.

As regards the secondary air supply, it may be mentioned that the majority of the regenerator passages in use in this country follow one of two types, viz.:—(1) The Siemens type, where the air passes upwards through one or two passages on each side of the producer in a continuous zig-zag direction, the passages being arranged parallel with the center lines of the retorts; and (2) the Klönne type, where the air passes upwards almost vertically, but is baffled about by small tiles in its course. Now, in the Siemens type of regenerator, the whole of the air is delivered into the chamber which feeds the air nostrils, either at one end or the other, and if combustion is to take place uniformly throughout the length of the retort the air must be delivered uniformly also, and the united areas of the air nostrils must not greatly exceed the united areas of the air passages. But usually there is no kind of proportion between them, the air nostrils often being five or six times the area of the passages. In all such cases the whole of the air gets into the setting through the first two or three nostrils, and severe local heating takes place, while half the length of the retorts gets but very little hotter than the gas from the producer.

In the Klönne type of regenerator the matter arranges itself somewhat differently, because there are two ways of regulating the air supply. First, the distributing chamber under the regenerator is made with outlets, increasing in size from the front to the back of the setting, so that some air will reach the back in any case, and then a further distribution can be made by regulating the area of the air nostrils.

Now, it is a handy rule to bear in mind that the volume of air required to burn a mixture of producer gas is the same as the volume of the producer gas, when allowances for difference in tempearture and surplus of air are made, consequently the air nostrils should also have a total area of 120 square inches for twelve nostrils (six on each side) 5 inches by 2 inches, or the equivalent. To supply all these nostrils it will probably be sufficient, in the Siemens type of regenerator, to allow 120 square inches of area of passage, because in calculating the area of the gas nostrils a co-efficient of contraction has been used to allow for the well-known effect of friction and sharp edges in reducing the delivery of orifices.

We very seldom find any such area allowed, however, and then the draught must be greater all over the setting to get sufficient air in to burn the gases, with the result that the heat is localized at a few nostrils, which rapidly melt away, and unequal heating results. Except just at the nostril, the larger the passage can be got the better, and it is also advisable to make the reduction by means of a tile which can easily be removed for cleaning purposes when the setting is out of order or when the retorts are being renewed. After all care has been taken in the design we cannot prevent odd pieces of brick or fireclay from getting into the nostrils when the retorts are being reset, and provision should be made to meet such exceptional difficulties.

Some engineers prefer a few very large nostrils both for gas and air in place of a large number of smaller ones; in either case there is no great difficulty in adjusting the areas to suit the circumstances.

The amount of draught to each setting is of vital importance in the working, and the regulation is by no means easy when many settings deliver into one main flue, for if the two dampers of each setting are fixed so as to give the desired draught at a given point in the setting when the atmosphere is in one condition, the whole scheme may be upset a dozen times in a day by changes in the direction of the wind. This can only be corrected by moving the chimney damper, and it is worth considering whether the automatic draught-regulators, now frequently used for boilers, would not find a useful place in a gasworks.

So essential to the good working of a setting is good control of the draught that Mr. Klönne shows in some of his advertisements a short chimney to each half of a single 10-feet setting, with a cap damper on the top of each.

Without a slight pressure in the top of a setting it is very difficult to get really even heats, yet too much pressure has the effect of reducing the heats, not by reducing the gas, but by checking the secondary air. Plenty of gas will usually get into the setting. Ample secondary air inlets and passages are a necessity for economical work.

In spite of the utmost care in design, bad results may come from careless construction. It is a most wearisome task to keep bricklayers from building settings as they would cottages. They look upon thin joints and fireclay spread over the whole surface of the brick as wilful waste and wanton ignorance of the true art of setting bricks; and though they may do what you tell them while you are near, as soon as you are away the clay is only put round the four edges of the brick, and the center is left hollow. In such cases leakage must ensue, and leakages are fatal to success. Too many sight-holes into the regenerative passages are detrimental and useless; removable bricks built in are better. Beware also how the connection is made between the outside of the chimney flue and the division walls of the Siemens type of regenerator. This is nearly always defective, because the division walls expand and draw away from the cross wall of the main flue, leaving a gap through which the air can get to the chimney at once without going into the setting at all. The best way is to tie a layer of casing bricks into the division walls, so that if these draw away from the flue the casing bricks will draw with them, still keeping the ends of the passages intact. The whole success of regenerator settings depends upon such small points as the foregoing, and when these are attended to there is no difficulty in making a large saving even in the smallest works. Indeed, there is but little doubt that the proportionate saving with settings of threes is greater than with nines; because where threes are in use coke sells generally at a high price, owing to the short supply.

The majority of the early difficulties with the inclined retort settings arose from imperfect heating of the retorts, and much undeserved discredit came upon the system itself, owing to imperfect carbonization. When the charges are not well burned off the trouble in getting the coke out of the retorts is great, and the labor exhausting and very disagreeable. But when the coke is well carbonized it will fall out of the retort without labor at all. In the earlier settings holes were burned into the retorts near the top end, while the bottom end could not be got red hot; and there are very few inclined settings now working which have not been reconstructed since they were originally put up, and the reconstruction has generally taken the form of a better proportioning of the nostrils to the volume of gas and air they have to supply.

The natural tendency of the hot gas is to go out into the setting at the highest point, and if the nostrils there are large enough all the gas will pass out at one end, and that is what formerly took place. The arrangement adopted by Mr. Graham (of Mansfield) consists of a small arched chamber built along the top of the producer arch and at the same slope. The producer arch has a few large nostrils delivering into this small chamber, while the latter has a large number of rather small nostrils distributed throughout its length. The operation is similar to that of a common boiling ring where perhaps a $\frac{3}{4}$ inch pipe is used to supply a dozen $\frac{1}{16}$-inch gas jets. The effectiveness of such a proportion is complete, but it would be far otherwise if the $\frac{3}{4}$-inch pipe were expected to supply half a dozen $\frac{3}{4}$-inch jets; and that is the existing condition of many horizontal settings, and was the condition of many inclined, only their construction gives room for the action of unequal heads of gases, and emphasizes all defects until they become intolerable.

Another modification which gives excellent results consists in the division of the setting into two halves by means of a 9-inch transverse wall carried up to the arch. The gas and secondary air supplies to each half are quite distinct, and can be regulated by separate dampers. Complete control is thus attained over the heating of the retorts, and the labor is reduced to its lowest limits.

In conclusion permit me to express my regret that the time at my disposal since Mr. Fenwick asked me to read a paper has been too short for the preparation of drawings which would have illustrated the matter better than pages of writing, and the same reason must be my excuse for the numerous omissions which you will all be able to detect.

Discussion.

Mr. W. R. Chester, Nottingham, on being called upon by the President, opened the discussion. He congratulated the author upon the manner in which he had dealt with his subject, a subject that bristled with controversial matter. To bring a paper of this description before a gas managers' association was something like bringing coals to Newcastle, for many members of the Association had had experience of regenerator furnaces extending over the past twenty years. One satisfactory feature about the paper was that it would enable them to see themselves as others saw them. Mr. Jenkins, of course, approached the subject from the standpoint of the outsider, and he brought his scientific training to bear upon what he considered some of the defects in regenerator furnaces; and he said that it ought to be possible to control the heating power of the furnace as easily as the power of the steam engine was controlled by regulating the valves. But the two things were entirely different. In the steam engine the power was derived from compression, whereas in the regenerator furnace the controlling power was a vacuum. That was a thing totally distinct from the pressure control of the steam engine. Where you had a vacuum—a natural force as against an artificial one—you might regulate your dampers to a certain point according to a standard in your own mind, but that would vary with the variation in the conditions at different gas works. Every variation in the size of the chimney affected the point at which a particular damper opening had to be arranged. The only way in which you could truly regulate the combustion in the regenerator furnace to the point of perfection was by analyzing the gases and setting the dampers for the primary and secondary air to give the correct pro portions in the products of combustion. Unless the regulation was based upon the percentages of the constituents of the products of combustion there could be no standard sizes of secondary or primary air nostrils, or of any other portion of the setting. Mr. Jenkins pointed to the possibility of one producer working more economically than two: but that depended entirely upon the conditions—upon the quality of the coke used for firing and upon the percentage of ash the coke contained. If you had a fuel containing only 5 per cent. of ash you might venture on one producer with perfect success, but if the fuel contained 20 per cent. of ash you could not get sufficient air to work with one producer with any satisfaction. Therefore the quality of the fuel must determine whether one or two producers were to be employed. It was a well-known fact that different temperatures gave different percentages of carbonic oxide, and you might carry the temperature up to 2,000°, when, perhaps, the highest percentage of carbonic oxide was obtained; but there was no necessity to carry the temperature to anything like that point. You could work at a less temperature than that; and the admission of steam into the producer also tended to lower the temperature to a point which would enable you to work a producer for twenty years without a single item of repair, provided you used a judicious admixture of fuel. The author of the paper referred to Mr. Carpenter's settings of six retorts. That was an admirable arrangement and gave a long combustion chamber, whereby the combustion was effected without being very severe upon the retorts. It was admirable for a setting of six retorts; but settings of sixes were not so economical as settings of sevens or eights. But when you got to eights you were somewhere about the practical limits. If you went to nine you found the arrangement of the retorts such that the combustion was very severe upon the bottom retorts, causing rapid destruction. Then such settings were not prac ticable unless where machinery was employed. The paper showed great care and thoughtful observation on the part of the author upon a subject somewhat out of the range of the mechanical engineer.

Mr. W. D. Child, Romford, scarcely appreciated Mr. Jenkins' suggestion that the producer should be controlled by an automatic damper. He could not catch for the moment what was to be the motive force of the automatic damper. If any such thing could be arranged it would be very desirable. By calculation, and noting the amount of fuel required to be expended, they could decide very nearly what the primary and secondary air openings should be, but the conditions of draught were constantly varying, and they then fell back upon the damper. But it was difficult to exercise very delicate control of the draught with the damper as ordinarily constructed, and therefore an automatic arrangement would be of very great use in the working of regenerator furnaces.

Mr. J. Barton, Peterborough, said the author of the paper recommended doors to the producer furnaces. He knew of four furnaces which had been working for between 300 and 400 days without any doors at all, but with an arrangement in front of the opening that caused the air to go immediately underneath the fire bars. That prevented the accumulation of clinker, and gave very economical results as regarded fuel consumption. But what suited one place would not suit another, and therefore no hard and fast rule could be laid down as regarded regulation. He preferred large nostrils, as he thought the more freedom there was the better for the regulation and for the maintenance of constant heats.

Mr. H. Wimhurst, Sleaford, thought that the paper would be useful to all those who were working regenerator furnaces. With reference to Mr. Barton's trouble with clinker, he thought if he had used proper drip plates for water supply he would not have found any clinker at the arch of the furnace nor any air taken in at that point. He had been working Winstanley's furnaces with very great success for about 12 months, and he found no clinker formed. But different qualities of coal gave different results. Mr. Winstanley informed him that he had not clinkered for 15 months, but he (Mr. Wimhurst) could not say that; he had to clinker about twice a week. The other day he had changed his coal, and that had upset his dampers altogether; at least he attributed it to the change in the coal.

Mr. Barton said his furnaces were fitted with proper drip plates and supplied with water, still the air found its way to the front of the furnace, simply because the coke was burned at that point. Since he had altered the arrangement the clinker had disappeared.

The President said, with regard to nostrils, that he preferred none at all. When he used nostrils he found that the retorts were cut away very much. Since he abolished the arch his heats had been as regular as he could possibly wish them to be, and his consumption of coke had decreased, but by how much he could not say.

Mr. Jenkins, in reply, said he was extremely obliged for the kind way in which his paper had been received. It had been prepared in a hurry to point out some of the difficulties he had met with in constructing regenerator furnaces under contract. As regarded the damper regulation, he knew one gas works where it was done in a scientific way, depending upon the position of the setting as regarded connection with the chimney. But that was an exception. Two producers were generally better than one, provided the amount of coke put into them was something like what it should be. But it frequently happened that the producer was working nearly empty for the greater part of the time, and then clinker formed. Where economy of fuel had to be considered the single producer stood a better chance—not as regarded the manufacture of gas, but as regarded the quantity of coke. With regard to the use of steam he was in agreement with Mr. Chester. He had seen a good many systems of water drips, but still he believed in steam, which seemed to have the effect of enriching the gas. The only case of blowing steam under the producer he had seen in England was at St. Helens, and that was Mr. Carpenter's setting of sevens which he had spoken of. With reference to Mr. Child's question, the damper was worked by draught. He did not know the maker of the damper, which was in use in several Lancashire works. The filling of the producer was a very considerable item in the work. If you could fill the producer always to the same level there would be no necessity for doors, but as that could not be done he thought the doors the better arrangement. It would be wrong to have two or three large nostrils when one was sufficient to take all the gas from the producer. That would be much the same as having side holes in a pipe when they wanted the gas at the end. The same remark applied to the steam and air supplies. They must have some proportion in the nostrils, to let the air go the whole length of the setting. Mr. Wimhurst's remark about the coal supply raised a question as to the practice in the north and the south. The furnaces might go without clinkering for three days in the south, whereas in Lancashire they might require clinkering every 24 hours. He was very pleased to hear the experience of the President with an open combustion chamber.

Ordinances Relating to the Disturbing of Street Pavements.

Municipal Engineering calls our attention to a matter that is receiving attention in Brooklyn, N. Y., over which the authorities there are attempting to regulate the practice that shall be followed respecting the tearing up and replacing of asphalt pavements by those who desire to uncover subway pipes, etc. A great deal of study has been devoted to the subject by Mr. N. P. Lewis, Engineer of Street Construction and

Maintenance, with the result that he has drafted a new set of rules relative to opening pavements, which their framer hopes will speedily go into effect. To obviate one of the effects of tearing up and relaying a new pavement, that of the repaired part settling or sinking, Mr. Lewis will provide that in addition to refilling the hole and hammering down the earth, 8 inches of Portland cement concrete must be laid beneath the upper paving. Mr. Lewis believes that this will make so strong a crossing that even if the earth beneath settles the concrete will sustain the pavement. He also thinks that it will be a benefit to the city to have all this repairing of torn up places done by one contractor instead of by a large number of contractors at varying prices as is done at present. It is uncertain, however, whether the work will be made a matter of competition, or whether the commissioner will select a contractor whom he knows to be in a position to look after it. The charge at present for a permit to open a pavement is $7 for a water or gas pipe, if no more than 4 yards of pavement is torn up. For sewer connections a charge of $10 is made for an opening, and in either case the city retains a dollar and pays to the contractor who does the work the rest of the money. Contractors who lay pavement for the city agree to keep such pavement in repair for five years, and if, in that time, an opening by permit is made, it has been the practice to give to the guaranteeing contractor the work of relaying the pavement over an opening.

The power of the City Works Commissioner in making rules regarding work of this kind was increased by the Legislature of 1896 by passing a law known as Chapter 825. This law makes it unlawful for any corporation or person to open any pavement without a permit from the Commissioner of City Works, and empowers the Commissioner to make reasonable rules governing the issue of permits and charging for the cost of inspection of any sort of repairing made necessary by such permit. An ordinance was passed by the Board of Aldermen October 21, 1895, which prohibits the granting of permits for tearing up asphalt pavements within five years of its laying, or stone paving within three years, except in cases of extreme necessity. The Department of City Works is also compelled to give subway companies interested 15 days' notice of any paving or repairing, so that each corporation may have an opportunity then to do any repairing to their pipes or wires that may be needed.

Engineer Lewis says that, "notwithstanding this ordinance, there are many cases in which the department is absolutely powerless to prevent the tearing up of a pavement. When a man builds a new house he has a right which cannot be abridged to get a connection with gas and water mains, and with the sewer. I am convinced that if in a case of that kind we refused to grant a permit a mandamus would stand to compel us to do so. This applies likewise to a bad leak that may be sprung in a gas or water main. Formerly it was the custom of corporations to first tear up the pavement and then kindly let this department know about it. Commissioner White compelled the companies first to get a permit from me, and even then they were not permitted to proceed with the work until the consent of the contractor who had guaranteed the pavement was secured. I am set on abolishing abuses in the tearing up of pavements, and have given the matter considerable attention. But it cannot be prevented altogether."

Under the new specifications the charges for a permit for opening will be, Mr. Lewis thinks, in the neighborhood of the charges made in Philadelphia and New York. In Philadelphia the charge for a permit for an opening in an asphalt pavement is $13, and this is increased to $18 between December 1 and March 1 of each year. In New York the charge is $4 a yard for asphalt, but the city never estimates on less than four yards, so that the amount for each permit is at least $16. A charge of $8 will be made for the first yard of granite paving, and $4 for each additional yard.

The Theory of Energy in Hydraulics.

[By L. M. Hoskins, Professor of Theoretical and Applied Mechanics, Leland Stanford, Jr., University.]

In text books on theoretical mechanics the theory of energy usually receives inadequate treatment. As a rule, little attempt is made to develop the theory logically from fundamental principles and definitions, while inconsistencies in the use of terms are often found which cannot fail to be confusing to the student. A like confusion is found in many works on applied mechanics, in the application of the theory of energy to practical problems. A reform in this matter is highly desirable in the interest of students, and is well worthy the attention of writers of text books. The following discussion is directed, not to the general subject here suggested, but to the application of the theory of energy in the single department of hydraulics.

The usual analysis of the transformations of energy in the flow of water is often perplexing to the student, since it seems to require an important departure from the conception of energy as applied in the mechanics of solid bodies. Writers commonly recognize in addition to potential and kinetic energy, a third form called pressure energy. Thus, in case of a stream of water in a condition of steady flow, any particle of water is said to possess energy by virtue of its mass and velocity (kinetic), by virtue of its weight and height above a horizontal reference plane (potential), and by virtue of the pressure to which it is subjected (pressure energy). As the particle moves with the stream, its velocity or its elevation may change, involving a loss or gain of its kinetic or potential energy; if the pressure also changes there is a gain or loss of the third kind of energy.

Consider the simple case of water flowing from a reservoir through a pipe, whose cross-section and elevation may be variable, and discharging into the air. To simplify the discussion, let it be assumed at first that there is no loss of energy by dissipation into heat, due to friction, impact among particles, or other cause, and that the velocity is the same at all points of any given cross-section. On this assumption it is well known that the following equation is satisfied:

$$z + \frac{p}{w} + \frac{v^2}{2g} = H = \text{constant}, \quad \ldots\ldots\ldots\ldots (1),$$

in which v, p, and z denote the velocity, pressure per unit area, and height above an assumed horizontal datum plane, of the particles in any cross-section; and w is the weight of unit volume of the water.

Let the equation be multiplied through by W, which is taken to represent the weight of any particle of the water, giving

$$Wz + W\left(\frac{p}{w}\right) + \frac{Wv^2}{2g} = WH = \text{Const.}$$

Of the three terms in the first member of this equation, two represent energy; Wz is the potential energy of the particle due to its weight and elevation above the assumed datum, and $\frac{Wv^2}{2g}$ is its kinetic energy. The remaining term $\frac{Wp}{w}$ is commonly said to represent the energy possessed by the particle in the form of pressure; and the equation is interpreted as equivalent to the proposition that the total energy of any particle of water remains constant during the flow. Thus, if B and C are any two successive cross-sections, and if the area of cross-section is greater at C than at B, while the elevation of the pipe decreases from B to C, the kinetic energy and the potential energy of the particle both decrease as it passes from B to C; but since the pressure must increase correspondingly in accordance with the above equation, it is said that the particle gains as much pressure energy as it loses of the other two forces.

A careful analysis shows that this is an erroneous use of the term energy, if the word is to retain its ordinary meaning. A body possesses energy when its condition is such that it can do work against external forces. This is the accepted meaning of the term, and to this use it should be confined. Now it seems clear that a body of incompressible fluid cannot do work simply by virtue of being under pressure. If water were perfectly incompressible, a volume of it confined in a cylinder by means of a piston could be subjected to a pressure of any intensity whatever without the performance of any work upon it. And conversely, it could do no work on the piston when the pressure was released.[1]

The term $\frac{W}{w}p$ cannot therefore properly be considered as representing the energy of the particle of water in question, and it is not true that the total energy of a particle remains constant during the flow. The total energy of a particle is in fact given by the sum of the two terms Wz and $\frac{Wv^2}{2g}$; and what the general equation states is that as a particle loses energy its pressure increases correspondingly. If the whole body of water is considered, its total energy remains constant unless it is imparted to some external body or system; but there is a continual interchange of energy among the individual particles.

A stream of water confined in a pipe acts as a transmitter of energy, just as a belt transmits energy from one pulley to another; and the pressure at any point in the stream shows the rate at which energy is transmitted by the particles at that point, just as the energy transmitted by a belt is proportional to the tension it sustains. To make the

1. This statement is practically true, even considering the actual compressibility of water. The work performed on a cubic foot of water in applying a pressure of 10 atmospheres would be less than 5 foot-pounds.

statement definite, it may be said that the term $\frac{p}{w}$ in the general equation means the energy transmitted (by pressure) across the given section per unit weight of water discharged.

Thus, let a denote the cross-sectional area of the pipe at a point where the pressure is p and the velocity v, and let the two portions of the fluid separated by the section be designated as X and Y. The total force exerted by X upon Y, and the equal and opposite force exerted by Y upon X, are each equal to $p\,a$; and the work done per second by one of these forces, and against the other is $p\,a\,v$, which therefore denotes the amount of energy transmitted from X to Y per second. The weight of water discharge per second is $w\,a\,v$. Hence, since $\frac{p}{w} = \frac{p\,a\,v}{w\,a\,v}$, it is readily seen that $\frac{p}{w}$ has the meaning stated.

To summarize, every particle of water is concerned in the transmission of energy in two ways:

(a) It possesses a definite quantity of energy (potential and kinetic) which it carries with it as it crosses any given section. This energy (per unit weight of the water) is represented by the terms $z + \frac{v^2}{2g}$.

(b) It receives energy from some adjacent particles and transmits it to others, by virtue of the pressure to which it is subjected. The energy thus transmitted across any section (per unit weight of water discharged) is represented by the term $\frac{p}{w}$.

The sum of $\frac{v^2}{2g} + \frac{p}{w}$ may now be interpreted as a whole. From the above analysis it is evident that it means the total energy carried across the given section per unit weight of water discharged. And the general equation (1) may therefore be interpreted as meaning that.

During any time, equal quantities of energy are carried across all cross-sections of the stream.

If losses of energy by dissipation, due to friction and similar causes, be considered, the general equation of flow is—

$$\left(z_1 + \frac{p_1}{w} + \frac{v_1^2}{2g}\right) - \left(z_2 + \frac{p_2}{w} + \frac{v_2^2}{2g}\right) = H' \ldots . (2)$$

in which the subscripts (1) and (2) refer to any two sections, and H' (called lost head) means the energy dissipated between the two sections per unit weight of water discharged. Interpreting as above the quantity $\left(z_1 + \frac{p_1}{w} + \frac{v_1^2}{2g}\right)$ denotes the energy carried across the section (1) per unit weight of water discharged, while $\left(z_2 + \frac{p_2}{w} + \frac{v_2^2}{2g}\right)$ denotes the like quantity for the section (2). In this case, therefore, the quantities of energy carried across different sections are unequal; the quantities carried across any two sections differing by the amount of the energy dissipated between.

The same principles are applicable in any case of steady flow of an incompressible fluid. No further analysis is needed for the purposes of the present discussion, whose object has been, first, to point out the error involved in the ordinary use of the term pressure-energy, and second, to indicate the correct method of applying the theory of energy in the ordinary problems of hydraulics.

The Aims of Technical Colleges.

The following abstract of an address, by one of the very foremost of Germany's professors of engineering (Prof. Riedler), who at the same time is an engineer practising with distinction, which means that he is in constant touch with the practical working requirements of engineers and of manufacturers, will interest many of our readers, even though the comment (which originally appeared in *The Engineer*) applies to England and to Germany rather than to this country.

"England is waking up to the fact that the modern craze for mixing up colleges and workshops is a dangerous one, and Germany is finding that the more she grows in practical commercial engineering the more the real workshop becomes the most important training ground. Consequently, she is reverting more to the old British practice. The German technical colleges have developed in the three last decades remarkably quickly, but quicker still has been the progress in the technical arts, and consequently also the growth of the demands made on technical education. If these demands are to be met, a reform of technical instruction is unavoidable.

"Knowledge of reality is the basis of technics, and with this, knowledge of nature, insight into physical things, not however mathematics, the true element of the engineer. This does not always receive due consideration in our colleges. All instruction, even in the highest grades, must be objective and yet combined with scientific accuracy. Here the prevailing school fails. How much the scholar has to learn in words and conceptions, how much is described to him in words, how much he has to describe, and how little is shown to him that he can see and observe, that he must himself represent in drawings or sketches! Such way of instruction deceives as to the difficulties of reality, and the consequence is fear and flight from reality. The school must develop the sense of observing accurately; exercise in this respect, the developed powers of observation and imagination must be brought to college just as the knowledge of languages, mathematics and drawing. But for technical activity knowledge alone without the capacity to put it into use is not sufficient. The practical application is necessary to complete the theoretical knowledge; it is the higher step in knowledge, general theoretical knowledge being the first.

"Knowledge without practical application is the cause of the growing disinclination of youth to do detail work, and at the same time of the increasing uselessness of those who have only scientific—*i. e.*, one sided—theoretical education. Anothor result is the decrease in self education by indepeudent work. The formal doing of the full amount of school work and passing the necessary examinations contributes its quota in keeping back youth from self education. The consequences are known: The mere acquiring of privileges, a mighty crowding, especially of the most talented, to get high positions where there is little work, to get an office attractive on account of the support and social position which it affords, holy horror of the struggle for existence, of productive work, of responsibility of all 'uncertain future.' Less serious persons are conceited, consider what they have learned sufficient for all active life, confuse self made suppositions with reality, and so superficiality, contempt of experience, overestimation of what they have learned, flourish. All their mental energy is expended in fruitless criticism, and they boast of superiority over all who have not reached the same rank in the same way of advancing. The entire rearing must be permeated by the practical spirit. The Germans tend by nature to the dogmatical, to dreaming, while the Anglo-Saxons take hold of everything from the very beginning practically and technically. Impractical sense is a German hereditary and educational mistake. On this account we must avoid excess of learned training; for this reason we need before all other things technical training, which teaches to think practically and put into use, which trains a practical and not a learned youth. The point of view of economy must receive more attention than heretofore in technical instruction. The knowledge of economics, of one's own country as well as of foreign countries, is becoming to-day more and more necessary. We live in a time when mistakes in economy weigh the heaviest, and when nations bleed to death more easily by them than on battlefields. With us the state and its officials exercise an unhealthful influence on the practical and economical sense, because all higher studies are arranged specially for the training of state officials. A great hindrance is the age that our students reach before they enter into active life. The gymnasial examination occurs often in the twentieth year, the builders' examination (*Bauführerprüfung*) in the twenty-fifth year; in the meantime our competitors in foreign countries have been already from five to seven years in active life. Since a military year is unavoidable, a shorter and more suitable preparation, and only a three years', but practical, fruitful college course must be the aim.

"The reform of technical education must be sought for in several directions. The training previous to technical instruction must also lay stress on the special capacities needed for technical activity; power of observation, of imagination for space and form, capacity of representing the objects of imagination by drawing, and before all else the capacity of correctly seeing things as they are. This demand is not filled at present. The scientific preparation in the colleges should not consist in abstract doctrine, but must from the beginning show the difficulties which arise in actual experience, and the application which alone leads to the complete mastery of the elements. The scholar can only put into use that of which he is master, that which he has digested. This demands the utmost limitation of the matter, and time for assimilation. The instruction in all the sciences must therefore for the average of the students be brought down to the necessary minimum, but this minimum be fully mastered and put into use.

"The study of the technical sciences has not for its aim to turn out perfect engineers, but it must so develop the capacities that practical life will seem only a natural growth from the instruction; it must train practical, responsible helpers, teach the varied conditions of reality, the practical application and execution for the special case. Also the technical sciences have to teach for the average of the students only the

fundamental principles, the amount that is absolutely necessary, but to demand complete mastery of that. The particular learning of engineering begins in practice. Necessary are: More thorough knowledge by means of practical application, and teachers who understand such application and work in the spirit of true practice and economy. The teachers of the technical sciences must be acquainted with the actual facts from their personal activity and must be masters of, and know how to put into practice, the art which they undertake to teach. On the other hand, opportunity for the highest special scientific training must be guaranteed, which is indispensable for the solution of numerous technical questions; such training, however, ought to be offered only to select students. Arrangements for examinations are necessary, which shall be of equal value with those for public service, but which correspond to technical activity, admit of the development of individuality, and prevent the abnormal crowding into State offices and the privileged course of education.

"In the technical colleges a lively mental competition of the teachers ought to be produced by parallel professorships, and by attracting teachers from practical life. The success of the colleges and of the national productive activity is dependent upon this. The damaging of an entire generation and nation by a single college teacher who is not capable of doing his work, or whom a false or outlived reputation surrounds, is much greater than the damage which dozens of dismissed army officers would have been able to do."

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE newly-elected Board of Directors of the Amherst (Mass.) Gas Company have perfected the following organization: President, Mr. Charles D. Bangs; Executive Committee, the President and Messrs. E. D. Bangs and E. D. Marsh. Mr. E. F. Cook was chosen a Director, in place of Mr. L. M. Hills, who declined to serve.

MR. OVINGTON E. WELLER, of Boston, Mass., has been appointed receiver of the Citizens Gas Light Company, of Reading and Stoneham, Mass. His bond was put at $20,000. Last week we reported that an application had been filed for the appointment of a receiver for this Company.

A CORRESPONDENT at Philadelphia forwards the following: "The West Chester (Pa.) Gas Company is demonstrating the fact of its being in touch with the times and the needs incidental thereto by supplying the wants of the people in the way of gas stoves and prepayment meters. This last product of the inventive mind in the line of gas apparatus is meeting with a large demand, and those who have it in their houses or places of business find it to be the proper thing in the way of giving a full return for every coin placed within the neat little contrivance. Gas fixtures and all else that pertain to the Company's line of business have been very much improved of late, and it is but in line with truth to say of the West Chester Company that it is giving to its patrons the best in the market, and, too, at a cost not exceeding a reasonable profit."

"W. S. T.," writing from Mobile, Ala., under date of the 29th of September, says: "Some days ago Messrs. Stedman and Stacey, stockholders of and Directors in the Florence (Ala.) Gas Light and Fuel Company, at the invitation of the Business Men's Association, of Florence, met several prominent citizens of that place for the purpose of placing before them the condition of the Gas Company's business, in the belief that such presentation would convince the residents that the Company was not receiving the patronage or support that its efforts to supply a good light seemed to command. The Company is considering the advisability of extending its main system, but it did not see its way clear towards making the expenditure involved unless the citizens would guarantee a certain amount of consumption from the extensions, either on account of use of gas in shops, residences, etc., or for public account, through an added number of street lamps. The parties who participated in the discussion agreed that the needs of the town required more lamps than are at present in use, and it is likely that the street lighting will be added to. If so, the Company will not only extend its main system but will also improve its manufacturing plant."

A BREAK in a main of the Bay City (Mich.) Gas Company caused an interruption to the gas service there which lasted for some hours. The break was caused by a washout on Water street, close to the Company's storage holder.

THE Chicago newspapers say that the Western Republic Construction Company, which is to build the plant of the Ogden Gas Company, of Chicago, has taken out permits for the construction of a number of buildings on property extending from 569 to 591 Hawthorne avenue. The buildings include an office, two stories high, extending over 50 by 38 feet; a two-story purifying house, 33 by 133 feet; a two-story generating house, 73 feet by 40 feet, and a boiler house, 73 feet by 32 feet.

THE proprietors of the Ilion and Mohawk (N. Y.) Gas Light Company have entered suit against the Board of Water and Light Commissioners of the village of Mohawk under which the defendants are required to show cause why the village should not be restrained from proceeding with the construction of an electric lighting plant to be operated on public account until the village had condemned and acquired the electric lighting plant of the plaintiff, which plant had been installed only because of defendant's declaration that plaintiff should perform the public lighting for a certain period, which period it is claimed will not be reached for several years.

THE Providence (R. I.) Company has had satisfactorily completed for it, by the Morton Iron Works, a steel lining on one of its old brick gasholder tanks.

THE improvements on the plant of the San Leandro (Cal.) Gas and Electric Light Company will be completed by November 1st.

AMONG those who suffered from the recent severe storm of wind and rain that swept certain parts of the South was the Staunton (Va.) Gas Company. Lewis creek, which runs through the city, overflowed its banks, and the result was much destruction of property. The gas works yards were converted into turbulent lakes, and the waters reached a point high enough to extinguish the fires under the retorts. The confusion and damage were all the greater because the storm was at its highest between 10 and 12 P.M. Superintendent Woodson, of course, lost no time in getting at the work of repair, and as a result the interruption to the gas supply of the city was minimized.

THE City Solicitor of Des Moines, Ia., has been instructed to draw up an ordinance providing for the testing of meters for measuring gas, water and electricity.

THE Board of Gas and Electric Light Commissioners, of Massachusetts, after a hearing on the petition of the Whitman Light and Power Company, of Whitman, for permission to issue capital stock in the sum of $25,000, and bonds in a like amount, for the purpose of purchasing the plant and property now or formerly owned by the Whitman Electric Company, took the petition under advisement. There was no opposition to the application.

THE following is the text of the amended ordinances relating to the administration of the Richmond (Va.) municipal gas works, in so far as the same apply to the way in which gas shall be paid for: "The amount of bills for gas of a consumer shall be paid without addition, provided such payment be made to the Treasurer, at his office, within five days next after presentation, and before 4 o'clock, P.M.; otherwise, 5 per cent. shall be paid in addition to the amount of the bills. If a bill for gas, or anything else which is furnished by the city in connection with the supply of gas, shall remain unpaid for 10 days next after that on which it is presented, the Auditor shall notify the Superintendent, who shall cause the gas to be stopped from the premises in respect to which the default exists, and not allow it to be used on the premises again until such bill shall have been paid, with 5 per cent. added as aforesaid, or 10 per cent., as provided in section 32; provided that the United States Government shall not be liable to have the above penalty imposed, and shall have such time for the payment of bills for gas furnished by the city as the regulations of the departments at Washington require; and, provided further, that a like exemption shall apply to the Commonwealth of Virginia, and such time be given the State authorities for the payment of bills for gas furnished by the city as may be required by the regulations of the Auditor's department. And provided, further, that whenever the Auditor shall be satisfied that a gas bill has not been properly delivered, or any error has been made in the reading of the meter, or in making out the gas bill, may relieve the consumer from the penalty prescribed by this section."

THE "Announcement and Programme of Lectures, 1896-1897," of the Franklin Institute, has been issued by Secretary Wahl. As usual, it shows how carefully the Institute arranges things for the benefit of its members, which arrangement is made and promulgated sufficiently in advance to enable the members to take full advantage of the good things in store for them. The "regular" lectures for the season of '96–

'97 will commence on Friday, October 30th, Prof. Edwin J. Houston being announced for that evening to lecture on the subject of the "X-Rays." The course then follows on the Friday evenings in November, December, January (save the first lecture in the latter month, which is set for the first Monday), February, March, April 2 and 9, and May 14, when the season closes. The list comprises 25 numbers, all on subjects of much interest, and all to be expounded by men of knowledge and reputation. The lecture set for Friday, March 12, which is to be delivered by Prof. D. S. Jacobus, of the Stevens Institute of Technology, will be of especial interest to gas men, for the Professor's subject bears the title, "Artificial Light: Modern Methods Compared—Electric Incandescent, Welsbach, Acetylene."

MESSRS. LAUFKOTTER & Co. have instituted suit against the Consolidated Electric Light, Gas and Power Company, of Woodlands, Cal., for the sum of $325, which complainants assert is due them on account of the construction of two oil tanks.

THE proprietors of the Pomona (Cal.) Gas and Electric Light Company have notified the residents that hereafter, or until further notice, the net rate per 1,000 cubic feet, to those who use 2,000 cubic feet or over per month, shall be $2.25 per 1,000. This is a concession of 25 cents.

THE Sacramento (Cal.) *Bee*, of September 30th, says that articles of incorporation have been filed with the Secretary of State by the Sacramento Gas and Fuel Company, formed to manufacture and supply gas for illumination and fuel. The principal place of business is San Francisco. The Directors are Messrs. F. R. Bell, J. H. Lounge and R. C. Semler, of San Francisco; Elmer Reed, of Oakland; and W. C. Wolfe, of Los Angeles. The capital stock is put at $500,000, of which sum $9,600 has been actually subscribed.

THE Citizens Gas Company, of Bridgeport, Conn., has set up an 11-horse power gas engine of the Otto type in a noted café on John street, in that city.

THE Cincinnati Gas Light and Coke Company has applied to the authorities for permission to open Montgomery turnpike, from the north corporation line to Deer Creek road, and along that road to Smith, for the purpose of putting in mains, and also to open Carthage avenue, from the north line of Norwood to the corporation line of Carthage. The purpose of the Company under the asked-for permission is to supply gas to the outlying districts of Norwood, Evanston and Carthage.

THE increase in output from the municipal gas works of Philadelphia for the month of September, 1896, as compared with September, 1895, amounted to 36,000,000 cubic feet. The increase in day output has been phenomenal.

THE Bakersfield (Cal.) Gas Company purposes to put down something over one-half mile of 6 inch pipe of the fiber variety.

THE D. M. Dillon steam boiler works, of Fitchburg, Mass., has the contract for putting in the new steam plant in the electric station of the Amherst (Mass.) Gas Company. The equipment consists of two 125-horse boilers, each 18 ft 6 ins. long by 6½ feet in diameter, and a steel stack, 70 ft. long and 42 ins. in diameter.

SOME time last month an Italian fruit dealer named Marino was detected by an inspector of the Rochester (N. Y.) Gas and Electric Company in the illegal use of gas. He had ingeniously connected up a service pipe, that had been formerly employed to supply gas to a tenant prior to Marino on the premises, with the house riser.

UNDER the new Ohio State Excise Law, through which certain companies are obliged to pay into the State Treasury a sum equal to one-half of 1 per cent. on the value of their properties as assessed, the following returns in the shape of tax rolls have been completed in respect of the values of the artificial lighting companies: Gas works (artificial), $3,828,448.94; gas plants (natural), $1,653,388.07; electric light plants, $2,011,957.70.

THE Capital Gas and Electric Light Company, of Frankfort, Ky., has just completed the rebuilding of its water gas apparatus. Two machines of the old Lowe type were remodeled or changed over to one double superheater set, and Superintendent Hathaway reports that the set is working splendidly. The Kerr Murray Manufacturing Company furnished the material, and Mr. Hathaway put it together.

THE Boston *Herald* for October 1st says: "The Gas Companies included in the Bay State gas combination filed their reports for the year ended June 30th with the Board of Gas and Electric Light Commissioners. Each Company has had a prosperous year as far as gross income is concerned, that of the Bay State Company being 19.4 per cent. larger than the previous year; of the Boston Company, 7 per cent.; of the Roxbury Company, 23.5 per cent.; of the Dorchester Company, 10 per cent.; of the South Boston Company, 16.4 per cent.

MR. CHARLES P. RUSSELL has been appointed General Superintendent of the North Adams (Mass.) Company's gas and electric lighting plants.

THE new gas rate at Salem, Mass., went into effect on the 1st inst. Under it the gross price is $1.60 per 1,000 cubic feet, with a rebate of 20 cents per 1,000 to those who pay their bills within 15 days.

THE City Council, of Kansas City, Mo., is still struggling over the proposition to formulate an ordinance to govern the office, and to prescribe the duties of an official inspector of gas and gas meters.

THE Flatlands (L. I.) Taxpayers' Association (Flatlands was the old town name of that section of Brooklyn now a part of the 32d Ward of Brooklyn), through its President, Mr. Henry G. Green, it is said will make arrangements with the Brooklyn Union Gas Company for laying mains through the streets of the 32d Ward, provided the citizens will subscribe a sum sufficient to pay for gas to 200 street lamps during the months of November and December. It is said the needed money will be secured without difficulty. No provision has been made in the city budget for street lamps for the Ward named prior to January 1st, and the taxpayers assert that if the mains are not put down before the frost seals the ground they may have to wait until April.

THE American Gas Engine Company reports a very satisfactory condition of trade. Several important orders have been booked (notable among which are two engines for the Marietta Street Railway Company, of Marietta, Ohio, of 100-horse and 60 horse, respectively), and negotiations looking to the placing of several others are in a forward state.

ACCORDING to the annual report of Captain Edward Burr, the engineering official in charge of the division of water and light supply of the District of Columbia, under the head of "Street Lighting," declares that that "service has been about the same as heretofore. The streets of this city are most difficult to light, owing to the great number of shade trees on the curb line. The heavy shade makes the use of arc electric lights at wide intervals generally unsuitable, and the limited appropriations make it impossible to extend this system even to all streets where the trees will permit. The trees are generally located so near the curb line that the lamp posts have to be set on practically the same line as the trunks of the trees, so that, even in winter, when trees are bare of leaves, the streets look gloomy at night as compared with those of most large capitals. Some experiments have been made with a view to a change in the type of lamp post and lantern to obviate this difficulty, but so far without developing anything that can be considered a satisfactory solution of the problem. The street lighting service, so far as the appropriations permit, has been satisfactorily executed. With the use by the contractor for naphtha lighting of an excellent burner, and a number of his own lanterns fitted for that special lighting, this service has been, during the past year, as satisfactory as its limitations will permit. A number of gas lamps in alleys he replaced with naphtha lamps to obtain the benefit of the all-night lighting provided for in the contract for naphtha lighting. With the adoption of all-night lighting in the gas service, of a schedule of 3,760 hours per annum, from July 1, 1896, an important advance has been made. This number of hours of lighting should be exclusive of the time required to light and extinguish the lamps, and the Act making appropriations for this service should be so worded as to remove the existing uncertainty as to this point. A marked increase is asked for in the appropriations for street lighting. The existing service is not satisfactory or in keeping with the high standards maintained in the other branches of the city government. Nearly all the streets are but dimly lighted, and many streets and populous alleys are not lighted at all. In many of the suburbs improvements are rapidly going forward, and there are not sufficient funds for establishing the absolutely necessary lights, even in those suburbs that are practically parts of the city."

THE AMERICAN GAS LIGHT JOURNAL

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PROPRIETORS.

EDITOR—Jos. R. Thomas, C.E.
ASST. EDITOR—T. J. Cunningham.
MANAGER—C. E. Sanderson.

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MONDAY, OCT. 12, 1896.

The Market for Gas Securities.

The market for Consolidated gas is perceptibly weaker since last time of writing, although we are unaware of any reason why the break should have occurred. The opening today (Friday) was made at 145 to 147. The fall business of all the city companies shows a very satisfactory increase over that of last year, which statement applies particularly to the last week of September and the first week of October, and the outlook for a heavy winter trade is undeniably good.

Equitable is bid 195, offered at 200, ex-dividend, and Mutual is 220 bid. The gain reported last week in New York and East River common was maintained, and the preferred also holds its own. There is a very fair volume of inquiry for these shares. Standard, both common and preferred, is steady to strong, and a good demand for city gas bonds is reported by many brokers. The feeling in local gas investment circles respecting the application of the projectors of the Metropolitan Fuel Gas Company to the Board of Aldermen for permission to lay pipes in the streets tends to belief that the scheme will not get beyond the "projected" stage. The Company avers that it will sell a "good fuel gas" for 50 cents per 1,000 cubic feet, and will pay the city 25 cents per lineal foot of pipe laid. The application is now in the care of the Committee on Lamps and Gas.

Brooklyn Union gas is a shade lower, but the Company's 5's are strong, at 105¼ to 105¾. Chicago gas sold below 60 this week. To-day the opening was 59¾ to 60¼. The best opinion about Chicago gas is that its legal troubles are in line of speedy settlement. Laclede common is at a better price than has ruled in it of late, and Bay State is at the extremely low figure of 11¼ to 11½. Cincinnati is stronger, some small lots having changed hands at 196. San Francisco gas is 94 bid.

Gas Stocks.

Quotations by Cochran & Close, Brokers and Dealers in Gas Stocks.
35 WALL ST., NEW YORK CITY.
OCT. 12.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$35,430,000	100	145	147
Central	500,000	50	150	..
" Scrip	220,000	..	100	.
Equitable	4,000,000	100	195	200
Bonds, 6's	1,000,000	1,000	105	.
" 1st Con. 5's	2,300,000	1,000	114	.
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	220	.
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	.	..	
Northern	150.000	50	79	80½
" Bonds	150,000	1,000	..	98
New York and East River	5,000,000	100	35	37
Preferred	2,000,000	100	60	70
Bonds 1st 5's	3,500,000	1,000	100	101½
" 1st Con. 5's	1,500,000	.	89	90½
Richmond Co., S. I.	348,650	50	50	..
" Bonds	100,000	1,000	..	.
Standard	5,000,000	100	80	82
Preferred	5,000,000	100	106	108
Bonds, 1st Mortgage, 5's	1,500,000	1,000	107	111
Yonkers	299,650	50	130	
Out-of-Town Companies.				
Brooklyn Union	15.000,000	100	88	92
" " Bonds (5's)	15,000,000	1,000	105¼	105¾
Bay State	5,000,000	50	11¼	11½
" Income Bonds	2,000,000	1,000	27	30
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	76	73
2d " " "	3,000,000	1,000	60	65
Buffalo Mutual	750,000	100	125	..
" Bonds	200,000	1,000	95	100
Central, San Francisco	2,000,000	..	95	..
Chicago Gas Co.	25,000,000	100	59¾	60¼
Chicago Gas Lt. & Coke Co.				
Guaranteed Gold Bonds	7,650.000	1,000	94	94¼
Columbus	1.069,000	..	..	65
1st Mortgage	1,085,000	..	..	96
Consumers, Jersey City	2,000,000	100	60	75
" Bonds	600,000	1,000	97	101
Cincinnati G. & C. Co.	7,000,000	100	196	197
Consumers, Toronto	1,600,000	50	184½	187
Capital, Sacramento	500,000	50	..	80
Bonds (6's)	150,000	1,000	..	.
Consolidated, Baltimore	1,000,000	100	..	62½
Mortgage, 6's	3,600,000	..	107	107½
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490,000	..	..	..
Detroit	4,000,000	..	32	33
" Con. Bonds	4,312,000	..	..	82
Equitable Gas & Fuel Co., Chicago, Bonds	2.000.000	1,000	..	101
Fort Wayne	2,000,000	..	78	83
" Bonds	2,000,000	..	..	88
Hartford	750,000	25	..	14
Indianapolis	2,000,000	..	115	130
" Bonds, 6's	2,650,000	..	99½	101½
Jersey City	750,000	20	180	..
Lafayette Gas Co., Ind.	1,000,000	100	80	85
Bonds	1,000,000	1,000	80	85
Louisville	2,570,000	50	..	..
Laclede, St. Louis	7,500,000	100	25½	26
Preferred	2,500,000	100	77	80
Bonds	9,034,400	1,000	90	92
Little Falls, N. Y.	50,000	100	..	100
Bonds	25,000	..	..	100
Montreal, Canada	2,000,000	100	200	.
Newark, N. J., Gas Co.	1,000,000	..	93	98
Bonds, 6's	4,000,000	.	123	..
New Haven	1,000.000	25	225	..
Oakland, Cal.	2,000,000	..	52	53¼
" Bonds	750,000	..	.	..
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	2,100,000	1,000	..	108
2d "	2,500,000	1,000	104	105
Peoples, Jersey City	500,000	50	..	175
Paterson, N. J.	.....	25	99	102
Rochester Gas & Elec. Co.	2,150,000	50	..	..
Preferred	2,150,000	50	88	..
Consolidated 5's	2,000,000		87½	90
San Francisco, Cal.	10.000,000	100	94	..
St. Paul Gas Light Co.	1,500,000	100	67½	70
1st Mortgage, 6's	650,000	..	84	87
Extension, 6's	600,000	..	..	..
General Mortgage, 5's	2,400,000	.	88	90
Syracuse, N. Y.	500,000	25	..	
Washington, D. C.	2,000,000	20	250	
Western, Milwaukee	4,000,000	100	60	63
Bonds, 5's	3,556,000	.	88	91
Wilmington, Del.	500,000	50	180	182

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OFFICE OF THE UNITED GAS IMPROVEMENT CO., DREXEL BUILDING, PHILA., Sept. 24, 1896.

The Directors have declared a quarterly dividend of 2 per cent. ($1 per share), payable on Oct. 15, 1896, to stockholders of record at the close of business Sept. 30. Checks will be mailed.

1112-3 EDWARD C. LEE, Treas.

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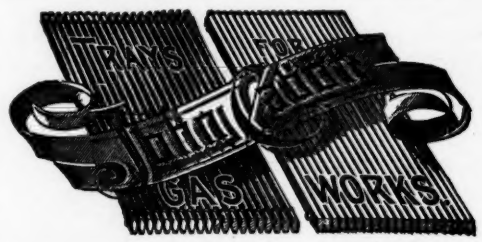

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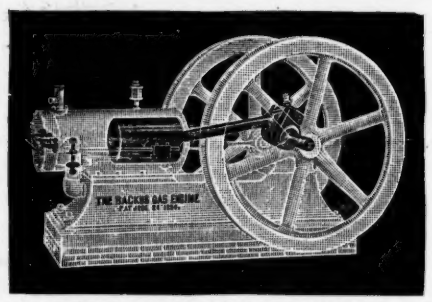

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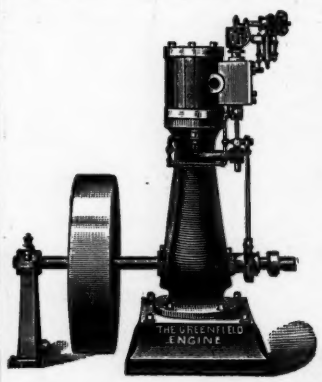

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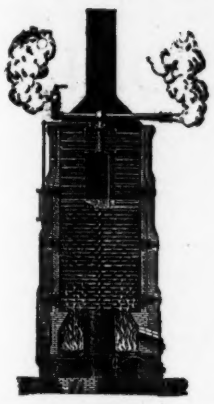

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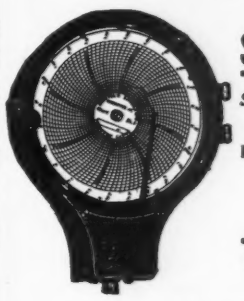

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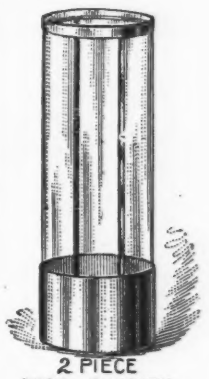

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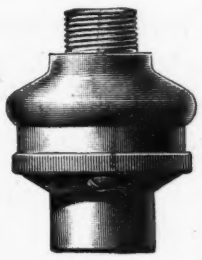

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To be He'd at MADISON SQUARE GARDEN, NEW YORK,

Two Weeks, Beginning January 25, 1897.

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W. M. EATON, Michigan Gas Asso. **J. A. BRITTON,** Pacific Coast Gas Asso. **IRVIN BUTTERWORTH,** Ohio Gas Light Asso. **GEO. T. THOMPSON,** Western Gas Asso.

PROSPECTUS.

THE object of the **Gas Exposition** is to bring together a collection of gas apparatus and appliances of every description, for the two-fold purpose of affording the general public and the gas engineer an opportunity to study the developments that have taken place in the gas industry during recent years. In submitting the plan of the Exposition to those who may feel an interest in the project, the management would call the attention of manufacturers of supplies of every description, entering into the manufacture of gas, to the great benefits which similar affairs have conferred on the industries of Great Britain, Germany and France, in which countries the exhibitions of gas appliances are held with recurring frequency. The creation of a healthy public sentiment in favor of gas is one of the first aims of large numbers of foreign gas companies.

MADISON SQUARE GARDEN.

In the selection of New York for the inauguration of an enterprise of this character, it is believed that no mistake has been made. In this city the Madison Square Garden is looked upon as one of the great show places of the metropolis; it contains within its walls the requisite space for the proper display of an almost unlimited amount of product, without which an affair of this kind cannot hope for the stamp of public approval—hence the selection of this great building for the inauguration of the gas industries exposition during the two weeks beginning January 25, 1897.

The greater New York contains a resident population of 3,000,000 people. Within a radius of 50 miles of Madison Square Garden live 4,500,000 people; reliable statistics show that an average of fully 100,000 strangers visit New York every day in the year. Thus it will be seen that the gas exposition will draw from a population of fully 6,000,000. In this connection it may be stated that every effort will be put forth that ingenuity can devise to thoroughly advertise the exposition, and create a desire in the minds of the public to come to the show; and once within its portals the dazzling brilliancy there abounding, coupled with the many attractive and instructive exhibits, will cause the visitor to wish to come again.

It is expected that cooking demonstrations will be a feature of the exposition. The lecture and concert hall, situated conveniently near the great amphitheater, in which the exposition is to take place, affords seating room for 1,200 to 1,400 people. The most experienced and talented ladies obtainable will be selected for this feature of the affair, which must prove one of the show's greatest attractions; not only for the housewives who may be attracted to it, but for gas managers, who will thus have an opportunity to study the advantages these gas cooking demonstrations offer as one of the means at hand for the education of people in the uses of gas.

APPLICATIONS FOR SPACE MUST BE MADE BEFORE OCTOBER 15th, 1896.

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CHICAGO,

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Gas Enriching Plants to Enrich Coal Gas up to 24 Candle Power, and Making a White, Bright, Non-smoking Gas.

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INJUNCTION ISSUED AGAINST INFRINGERS.

On September 23d the United States Circuit Court for the Southern District of New York granted an injunction restraining and enjoining the further infringement of our Welsbach patent. READ IT.

UNITED STATES CIRCUIT COURT,
Southern District of New York.

WELSBACH LIGHT COMPANY,
vs.
A. LIEBES.
} IN EQUITY.

The President of the United States,

TO A. LIEBES, and his servants, agents, attorneys and workmen, GREETING:

WHEREAS, It has been represented to us in our Circuit Court of the United States for the Second Circuit and Southern District of New York, that Letters Patent of the United States No. 438,125, were issued in due form of law on the 7th day of October, 1890, to Carl Auer von Welsbach, assignor of the complainant, then known as "Welsbach Incandescent Gas Light Company of New Jersey," and that the complainant herein is the owner of said Letters Patent, and that you, the said A. Liebes, have infringed the rights secured by the aforesaid Letters Patent, by making, using and selling to others to be used, incandescent devices for gas burners, embodying and containing the invention and improvements described and claimed in said Letters Patent No 438,125.

NOW, THEREFORE, We do strictly command and enjoin you, the said A. Liebes, and your attorneys, agents, servants and workmen under the penalties which may fall upon you in case of disobedience, that you forthwith and forever desist from directly or indirectly making, or causing to be made, delivering, vending, or causing to be sold, offering for sale, using, or causing to be used in any manner, any incandescent devices for gas burners, like, or similar to those which you have heretofore made, used or sold, containing or embodying the invention and improvements described in said Letters Patent No. 438,125, and claimed in the claim thereof, and from counterfeiting or imitating the said invention or improvements or any part or parts thereof, and from in any manner or way whatsoever, violating or infringing the said Letters Patent No. 438,125 and the claim thereof, and from doing, or causing to be done, any other act or thing whatsoever in infringement of the said Letters Patent No. 438,125.

WITNESS, The Honorable Melville W. Fuller, Chief Justice of the United States, at the City of New York, in the Southern District of New York, this twenty-fourth day of September, A. D., 1896.

(SEAL) JOHN A. SHIELDS, Clerk.

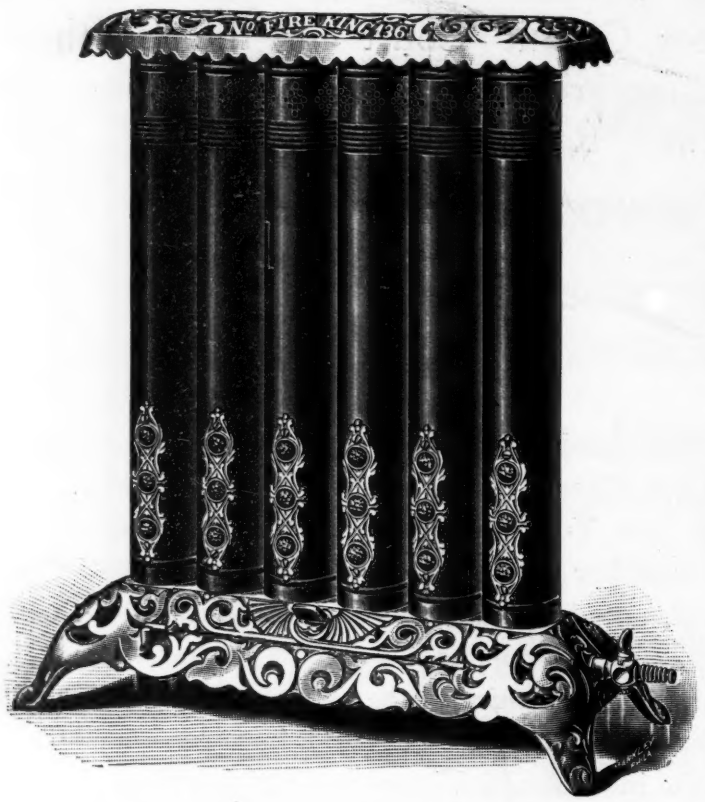
(Endorsed) U. S. Circuit Court, Southern District of New York, in Equity.—Welsbach Light Company vs. A. Liebes. Injunction.

A Copy of a Writ of Injunction this day issued out of my office. JOHN A. SHIELDS, Clerk.

We shall proceed against all infringers; manufacturers, dealers and users being equally liable to injunction and damages The decree of the court awarding the injunction also awards profits and damages. Do not be misled or deceived by guarantees offered by infringers, as such guarantees will not protect you against suit, injunction and damages. For your own protection see that you get the genuine Welsbach light. All other incandescent gas lights are infringements.

WELSBACH LIGHT COMPANY.

FIRE KING GAS HEATERS



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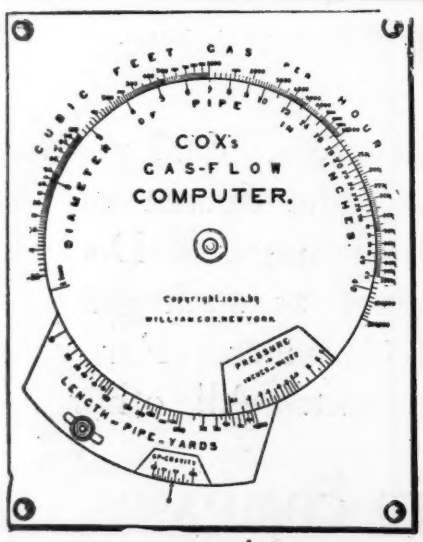

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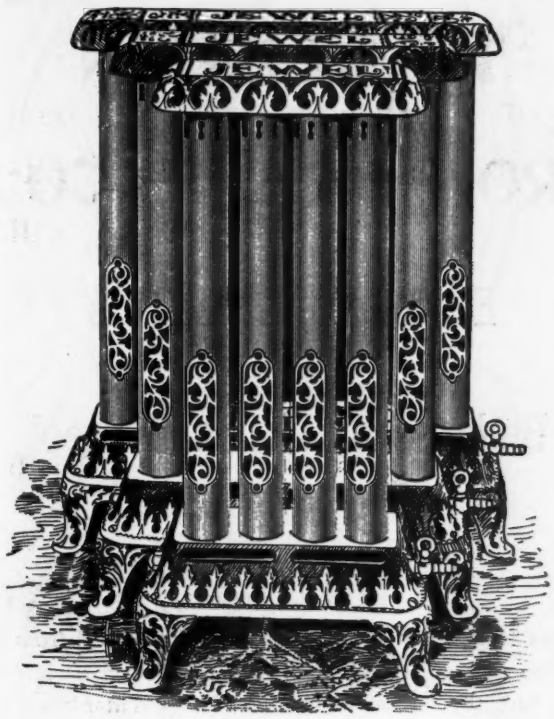

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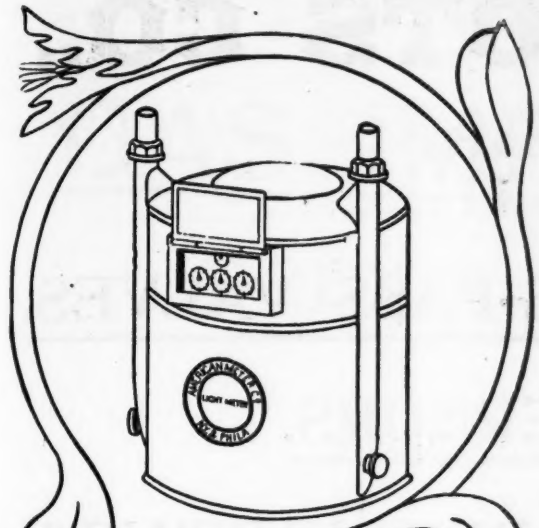

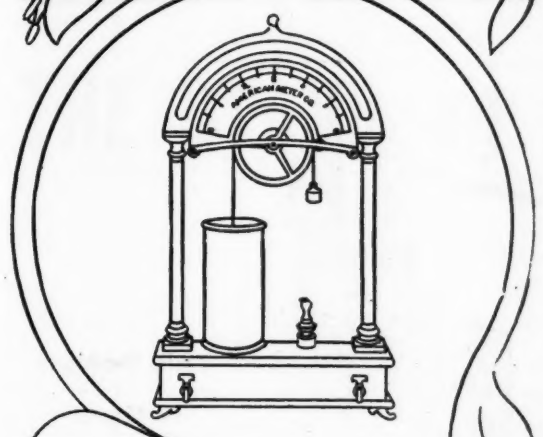

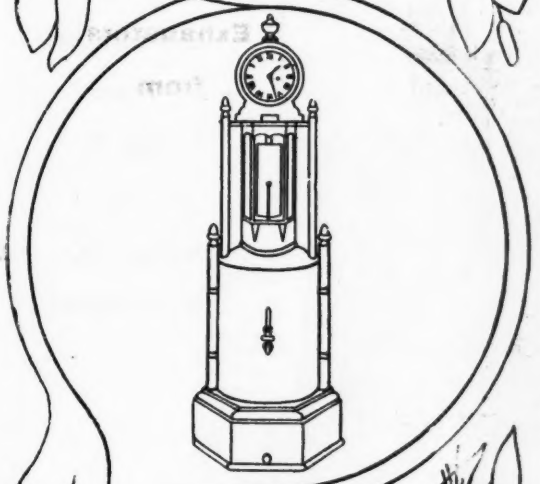

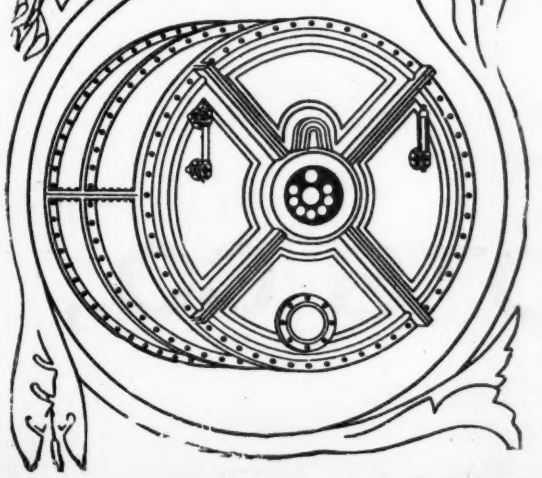

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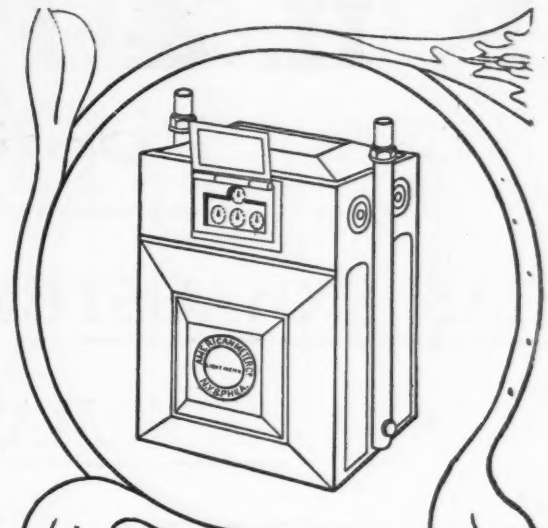
PUBLIC LIGHTING TABLE.

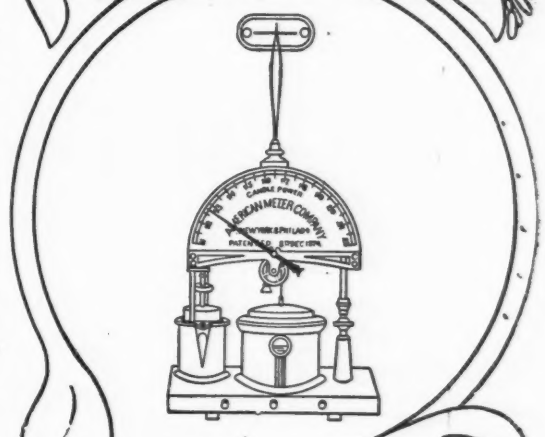
OCTOBER, 1896.

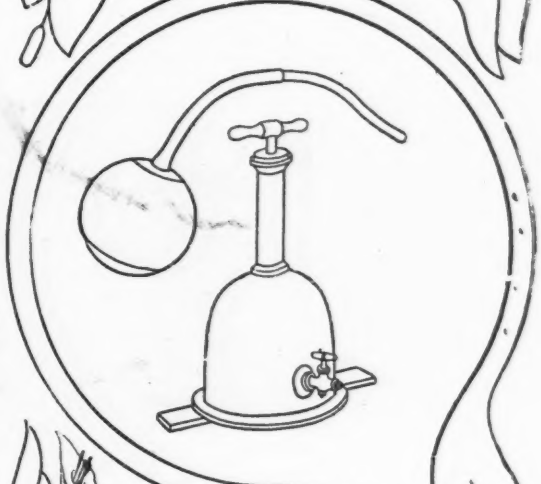
Day of Week.	Table No. 1. Following the Moon. Date.	Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A M.
Thu.	1	6.10 PM	1.30 AM	5.30	5.00
Fri.	2	6.10	2.50	5.30	5.00
Sat.	3	6 10	5.00	5.30	5.00
Sun.	4	6.00	5.00	5.30	5.00
Mon.	5	6.00	5.00	5.30	5.00
Tue.	6	6.00 NM	5.00	5.30	5.00
Wed.	7	6 00	5.00	5.30	5.00
Thu.	8	6.00	5.00	5.20	5.10
Fri	9	6.00	5.00	5.20	5.10
Sat.	10	6.00	5.00	5.20	5.10
Sun.	11	7.50	5.10	5.20	5.10
Mon.	12	9.00	5.10	5.20	5.10
Tue.	13	10.10 FQ	5.10	5.20	5.10
Wed.	14	11.10	5.10	5.20	5.10
Thu.	15	12.20 AM	5.10	5.10	5.20
Fri.	16	1.20	5.10	5.10	5.20
Sat.	17	2.20	5.10	5.10	5.20
Sun.	18	3.20	5.20	5.10	5.20
Mon.	19	4.20	5.20	5.10	5.20
Tue.	20	No L.	No L.	5.10	5.20
Wed.	21	No L. FM	No L.	5.10	5.20
Thu.	22	No L.	No L.	5.00	5.30
Fri	23	5.40 PM	6.50 PM	5.00	5.30
Sat.	24	5.40	7.30	5.00	5.30
Sun.	25	5.30	8.10	5.00	5.30
Mon.	26	5.30	9.10	5.00	5.30
Tue.	27	5.30	10.10	5.00	5.30
Wed.	28	5.30	11.20	5.00	5.30
Thu.	29	5.30 LQ	12.30 AM	4.45	5.35
Fri.	30	5.30	1.40	4.45	5.35
Sat.	31	5.30	2.50	4.45	5 35

TOTAL HOURS LIGHTING DURING 1896.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	220.40	January	423.20
February	207.00	February	367.40
March	193.00	March	355.35
April	174.10	April	298.50
May	164.00	May	264.50
June	142.10	June	234.25
July	142 10	July	243.45
August	150.50	August	280.25
September	163.00	September	321.15
October	193.10	October	374.30
November	207.00	November	401.40
December	237.30	December	433.45
Total, yr.	2194.40	Total, yr.	4000.00







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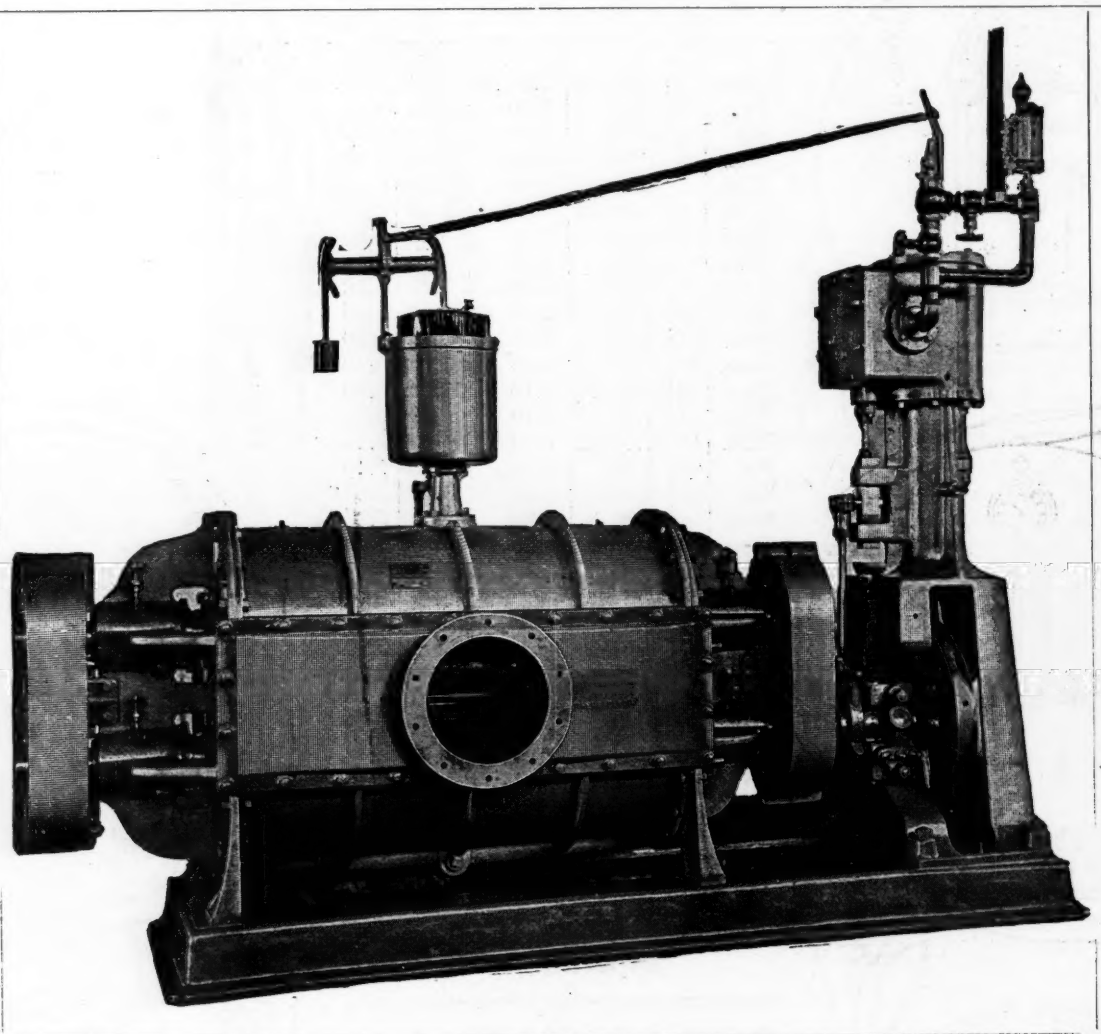

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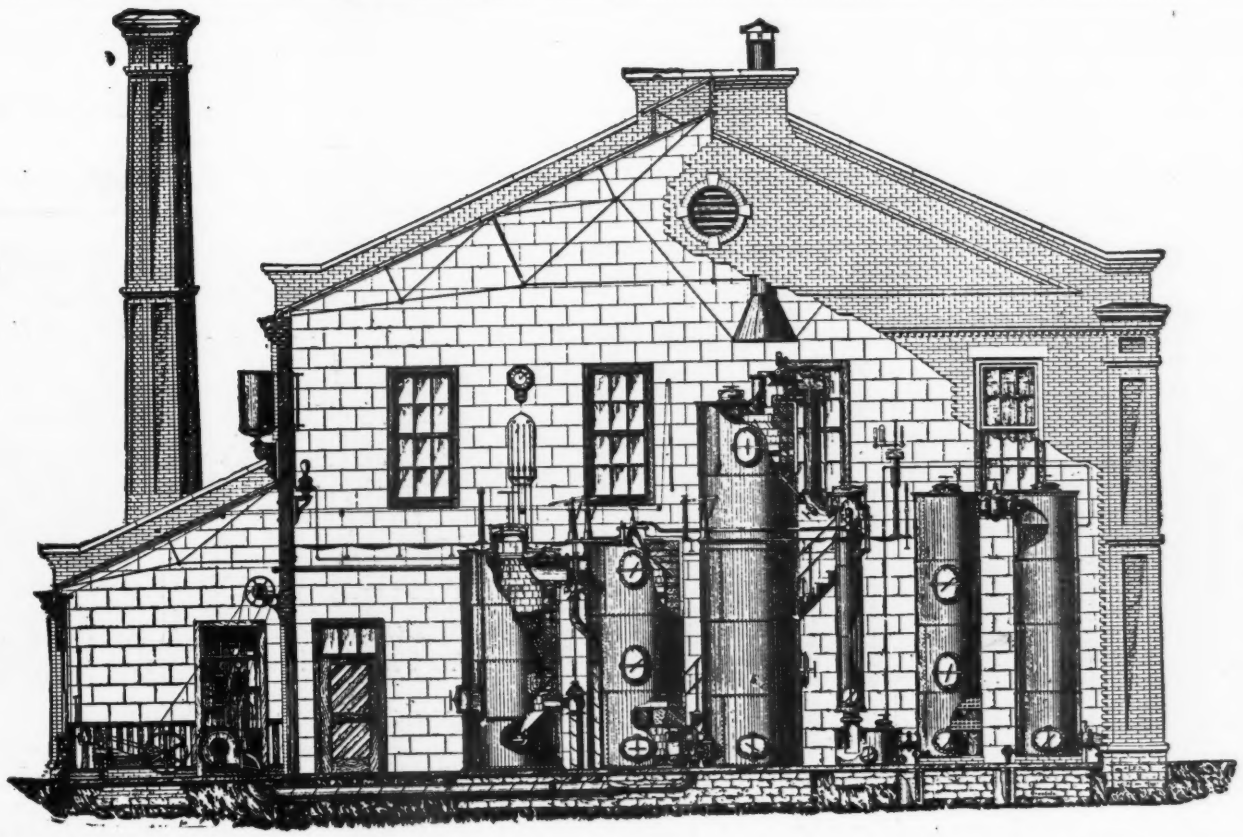

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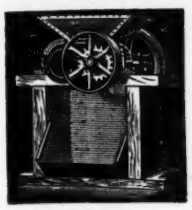

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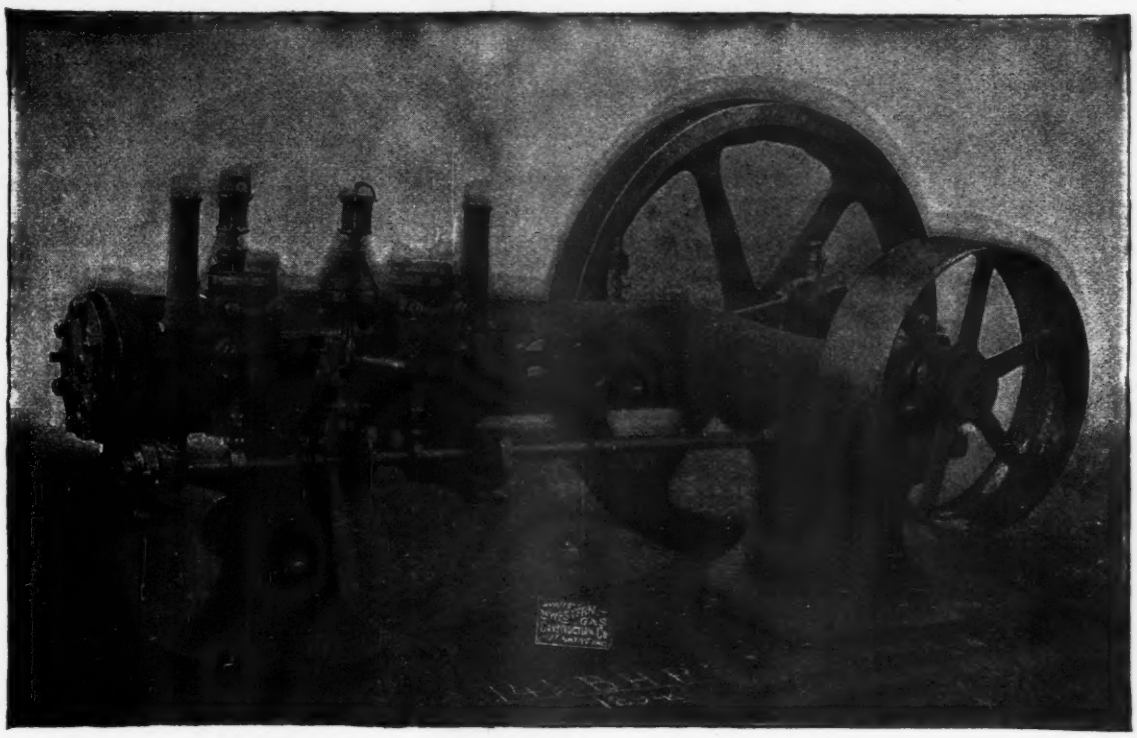

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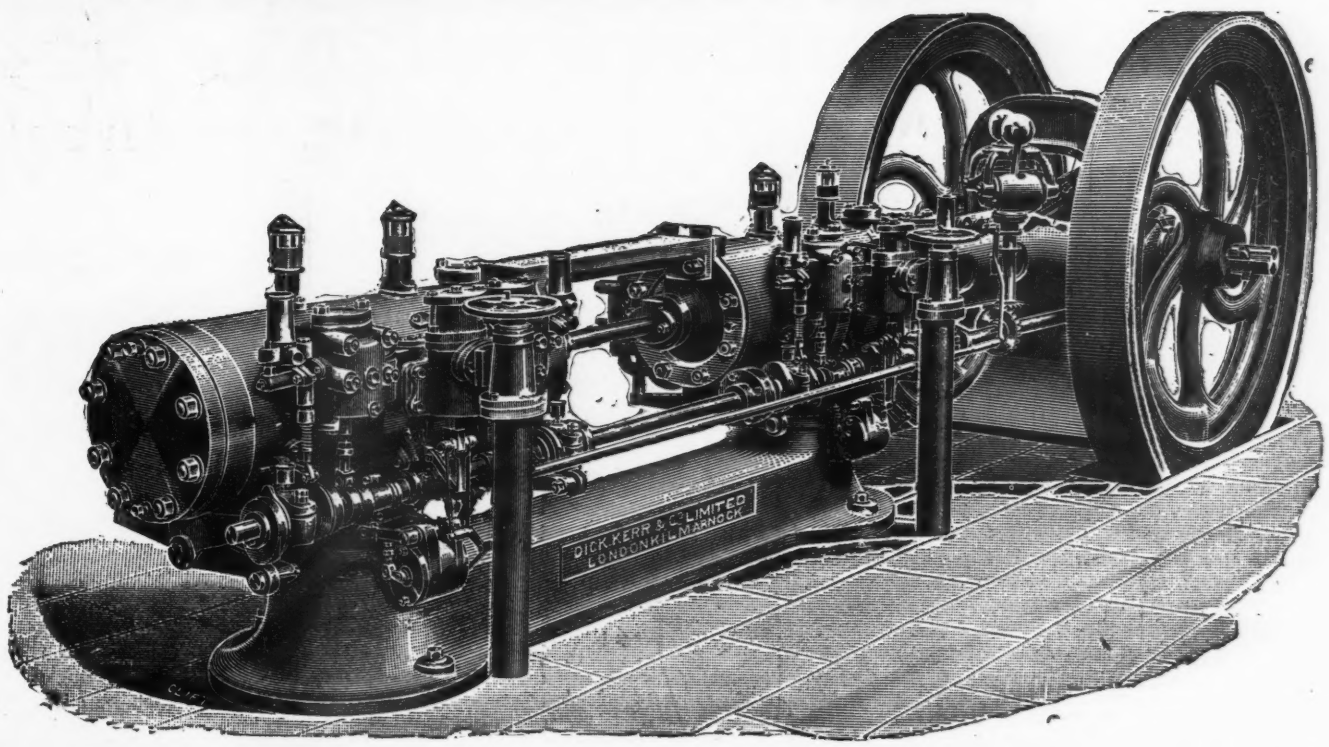

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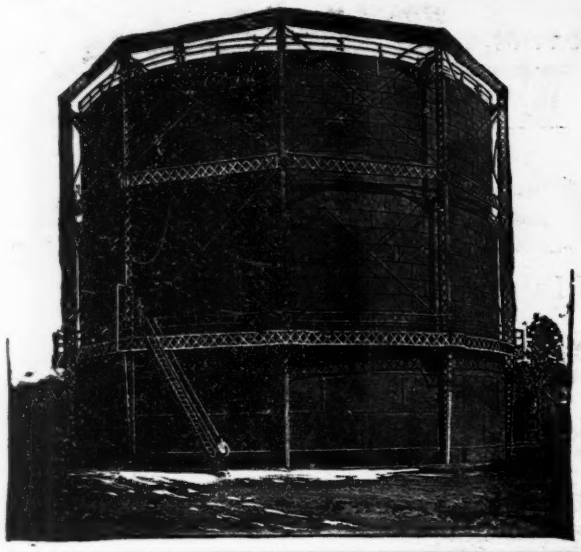

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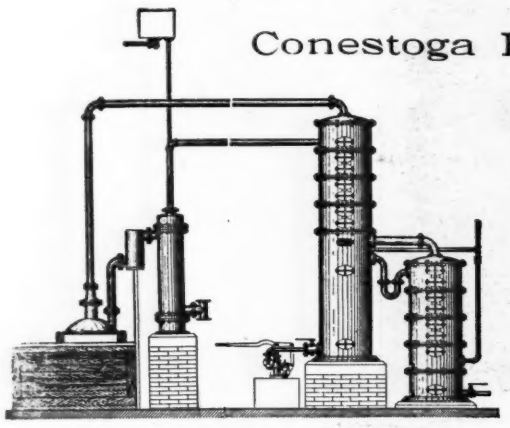

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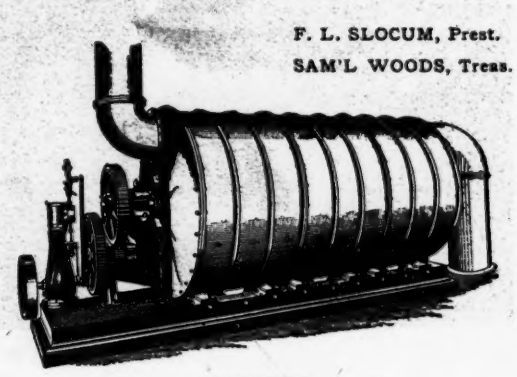

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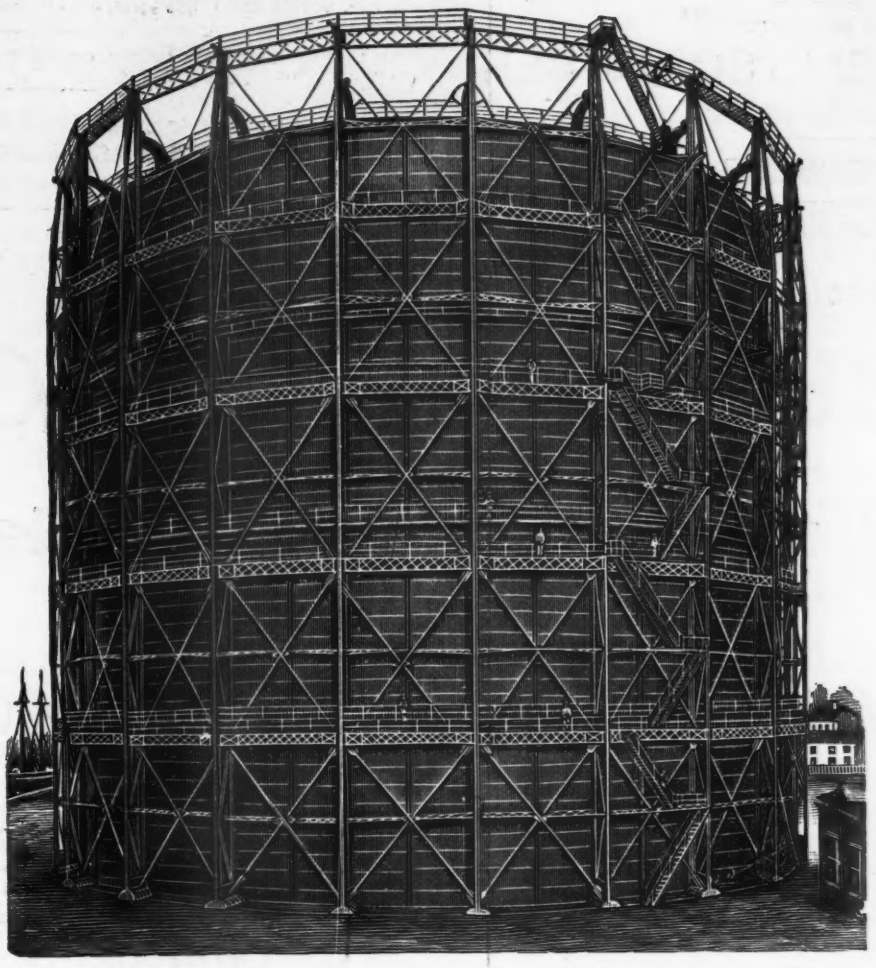

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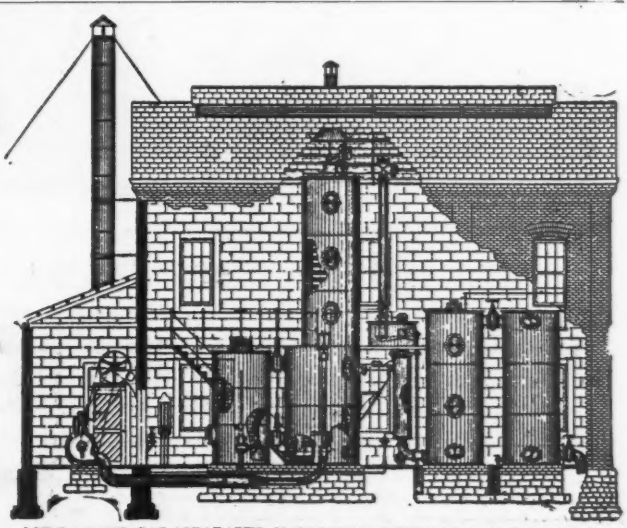

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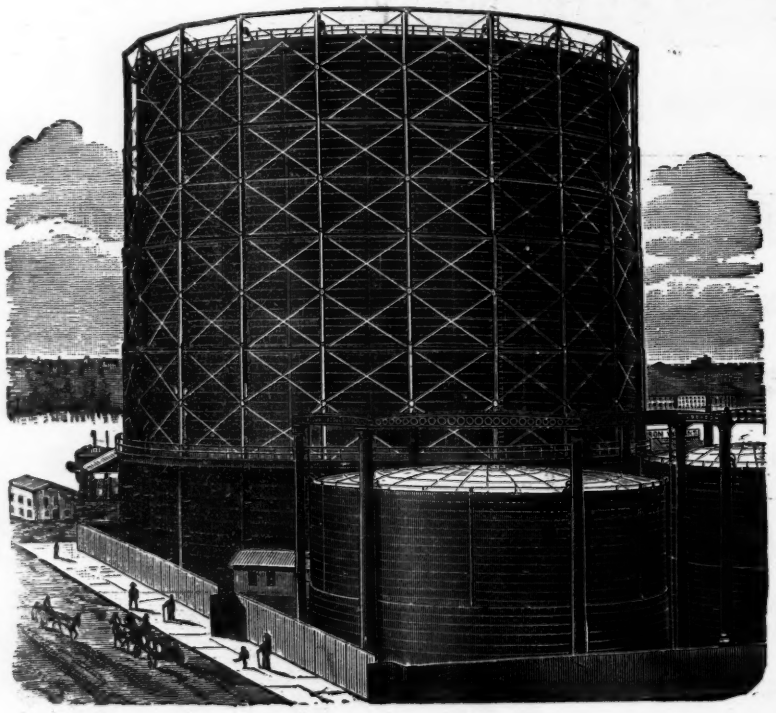

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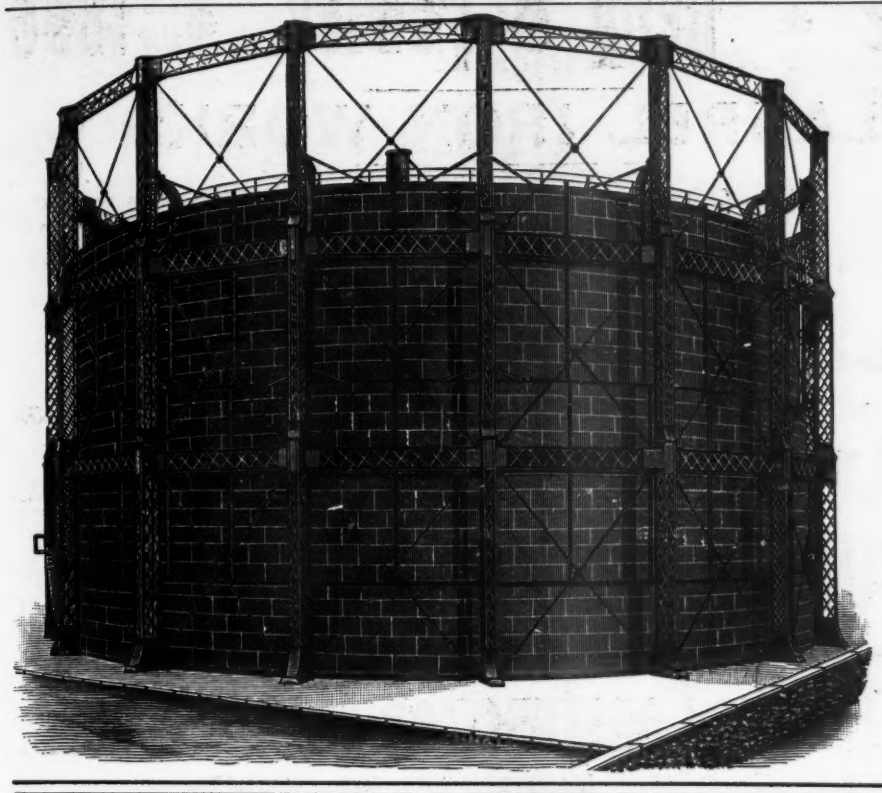

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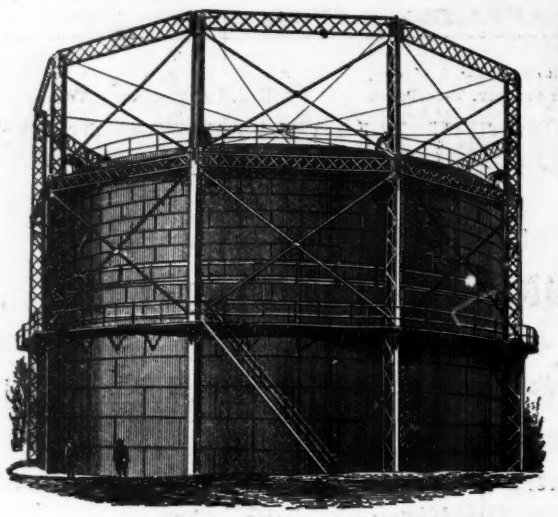

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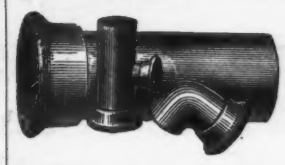

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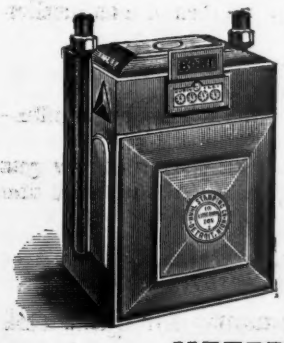

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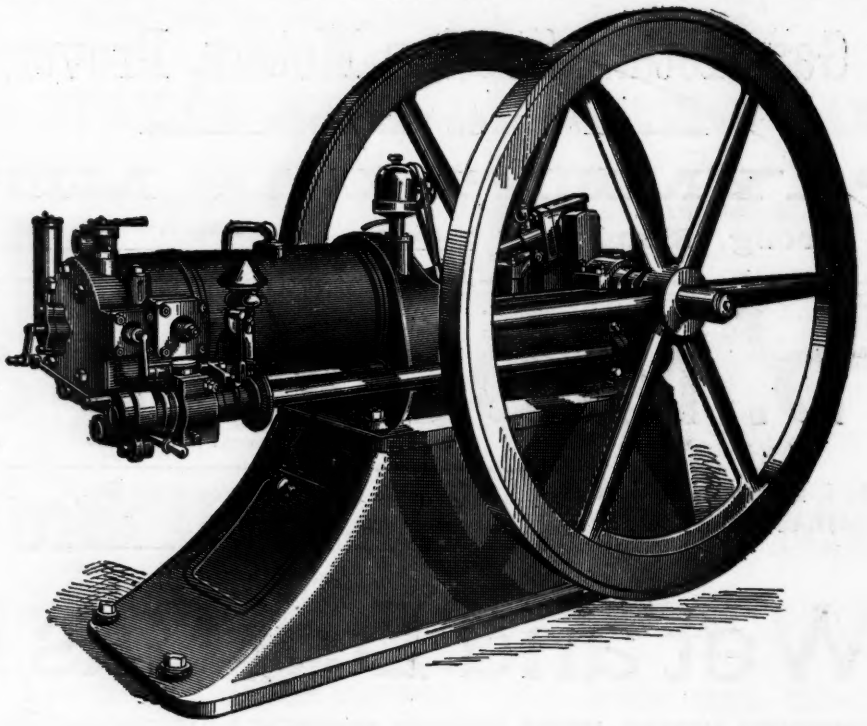

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